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April 15, 2022

Mr. Chan Pongkhamsing
EPA Remedial Project Manager
U.S. EPA Region 10
1200 Sixth Avenue, ECL 111
Seattle, WA 98101

RE: Response to Comments on the *Draft Farm Ponds Parcels Restoration Completeness Evaluation*

Dear Mr. Pongkhamsing:

This letter is in response to the U.S. Environmental Protection Agency (EPA) comments from March 17, 2022 and Oregon Department of Environmental Quality comments from April 4, 2022. Since the submittal of the *Draft Farm Ponds Parcels Restoration Completeness Evaluation* in February, ATI has collected the additional metals samples from monitoring wells PW-40A, PW-40S, PW-43S, and PW-44S in March 2022, and the results are included in the attached *Farm Ponds Parcels Restoration Completeness Evaluation* report.

EPA General Statement

The following comments are made because EPA guidance *Recommended Approach for Evaluating Completion of Groundwater Restoration Remedial Actions at a Groundwater Monitoring Well* (EPA, 2014) may have been mis-interpreted.

ATI Response

While the *Draft Farm Ponds Parcels Restoration Completeness Evaluation* was based on the EPA guidance document, it was also based on discussions with EPA and DEQ in April 2020 and June 2020 as well as the methodology established in the *South Extraction Area Restoration Completeness Evaluation* (GSI, 2021). Both 2020 meetings specifically discussed how to apply EPA's guidance document to Millersburg Operations. Therefore, the *South Extraction Area Restoration Completeness Evaluation* was drafted based on both the EPA guidance document and discussions with EPA and DEQ. EPA approved the *South Extraction Area Restoration Completeness Evaluation* and its methodology in EPA's comments on the *Millersburg Operations* Remedial *Action Progress Summary Year 2020* dated May 6, 2021 (See General Comment 1[1]).

EPA Comment #1

Section 1.1 – COCs should be based upon historical exceedance (as stated in the report) and on the ROD.

ATI Response
COCs were based on the Record of Decision (ROD) in addition to historical exceedance. To clarify this, a reference to basing COCs on the ROD was added to Sections 1.1 and 2.1.

EPA Comment #2

Section 2.3, Criteria for End of the RMP – EPA guidance states that "In general, it is recommended that a minimum of four data points be used to make this conclusion. The number of data points needed may be more than four, depending on both data behavior and the types and confidence levels of statistics that may be desired." This is more involved than the statement in the report that "The RMP continues until there are four consecutive analytical results….".

ATI Response
Section 2.3 will be revised to include "minimum" in discussing the four data points used for the remediation monitoring phase (RMP). ATI acknowledges that more than four data points may be needed. An example from the *Draft Solids Area Restoration Completeness Evaluation* is fluoride, where more than four data points were used for the RPM at monitoring well PW-18B (GSI, 2022).

EPA Comment #3

Section 2.3, Criteria for End of the AMP – EPA guidance states, "…it is recommended that a minimum of eight data points be used in these analyses." This is different than the statement in the report that "The AMP is evaluated using eight analytical results….".

The least squares regression line approach used in the report is useful for trend analysis, but the end of the AMP is evaluated using the upper confidence limit value compared to the cleanup level. Guidance states, "If both the UCL value is at or below the COC cleanup level and the time-dependent trend line has a zero or statistically significant negative slope, it may be appropriate to conclude that the attainment monitoring phase has been completed for the COC being evaluated."

ATI Response
Section 2.3 will be revised to include "minimum" in discussing the eight data points used for the attainment monitoring phase (AMP). ATI acknowledges that more than

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[1] EPA's General Comment 1 (EPA, 2021) states "Attachment B is a good start towards optimizing wells in the southeast area and a good approach for tackling the other areas." It should be noted that this is referencing the *South Extraction Area Restoration Completeness Evaluation*, which was Attachment C of the document.

eight data points may be needed. An example from the *Draft Solids Area Restoration Completeness Evaluation* is fluoride, where more than eight data points were used for the AMP at monitoring well PWA-1 (GSI, 2022).

ATI does not agree that an upper confidence limit (UCL) is needed for every constituent/well pair at the end of the AMP. Part of the 2020 discussions with EPA was an agreement that statistics were to be used as an aid to visual methods (tables, time-series plots) when visual methods were not clearly indicating a stable or decreasing trend. When statistics are utilized, a least squares regression line, Mann-Kendall Analysis, and UCL are all presented.

EPA Comment #4

Section 2.3, Semi-quantitative methods, bullet 1 – The statement that "The semiquantitative RCE may be performed if there are two or more data points after remedy implementation concluded in 1999" and the subsequent decision-making criteria are not EPA guidance and require further consideration.

ATI Response
This approach was discussed with EPA in April and June 2020, and was included in the *South Extraction Area Restoration Completeness Evaluation* (GSI, 2021), although it was termed as a qualitative method rather than a semi-quantitative method. EPA approved the methodology used in the *South Extraction Area Restoration Completeness Evaluation* (EPA, 2021). See additional discussion regarding the semi-quantitative method in the response to EPA Comment #8.

EPA Comment #5

Section 2.3, Semi-quantitative methods, bullet 2 – The discussion of TCA seems reasonable. A discussion of historical concentrations above the detection limit and any discernable trend in those historical concentrations would further support the reasoning.

ATI Response
Unfortunately a trend for TCA is not possible because there are insufficient detections. As discussed in Section 3.3.2, there have been no detections of TCA above the method reporting limit since 1996 and there has only been a single detection above the method detection limit, which is an insufficient number of detections to perform a trend analysis.

EPA Comment #6

Section 4 – Consider preparing a figure that shows wells still in RMP, wells still in AMP, and wells to be used for future sentry or compliance monitoring.

ATI Response
A figure similar to Figure 4 from the *Draft Solids Area Restoration Completeness Evaluation* (GSI, 2022) has been be created in the attached *Farm Ponds Parcels Restoration Completeness Evaluation*. This figure identified each well as either (1) restoration complete, decommission, (2) restoration complete, sample every 5 years, or (3)

restoration incomplete, continue sampling with constituents of concern identified on the figure.

EPA Comment #7

Section 4 PW-104S bullet – CVOCs might be associated with well materials. Consider installing a well near PW-104S to check that CVOCs are in groundwater. Future RMP monitoring in PW-104S should include daughter products (1,2-DCE and VC) and a downgradient sentry well should be monitored as well.

ATI Response
ATI will take EPA's suggestion of installing a new well into consideration. As indicated in Section 4, PW-104S will continue to be sampled annually for the full EPA Method 8260 list which includes 1,2-dichloroethene and vinyl chloride. A downgradient sentry well (PW-64S) was also identified in Section 4 and will be monitored every five years for the EPA Method 8260 list.

EPA Comment #8

Section 4 metals - Further discussion of the "one more sample" method is warranted. Ensure that total metals are analyzed to include colloidal fraction. Designate sentry well(s) until final decision is made.

ATI Response
As described in Section 2.3, the semi-quantitative method is used when the constituent has not historically been considered a constituent of concern for the well and/or area. The same approach was used in the EPA approved *South Extraction Area Restoration Completeness Evaluation*. A typical example in the Farm Ponds Area is an exceedance of a metal in 1991 with only one recent (e.g., 2016) analytical result for the evaluation. In the semi-quantitative method, ATI has chosen a more conservative action in that two results are required (rather than one) for the evaluation[2].

ATI collected the total metals "one more sample" in March 2022 and results were either non-detect or significantly below the cleanup level. The attached *Farm Ponds Parcels Restoration Completeness Evaluation* includes the March 2022 metal analytical results and an updated restoration completeness evaluation for these constituent/well pairs, with an outcome that these outstanding metals are now considered restoration complete.

EPA Comment #9

Section 4 background wells - Consider keeping some background wells for determination of background concentrations for the site and for water levels.

ATI Response
ATI will take this comment into consideration.

[2] Note that the "semi-quantitative method" was called the "qualitative method" in the *South Extraction Area Restoration Completeness Evaluation*.

EPA Comment #10

Section 4 sentry wells - Consider designating PW-41A for a metals sentry well and PW-105S for a CVOCs sentry well.

ATI Response
As indicated in the beginning of this letter, the additional metal samples were collected in March 2022, with the results being either non-detect or detected below the cleanup level. These metal results have been included in the attached *Farm Ponds Parcels Restoration Completeness Evaluation*, and show that these constituent/well pairs are now considered restoration complete. Therefore, no metal sentry well is needed.

As described in Section 4, monitoring well PW-64S will be the sentry well for CVOCs.

EPA Comment #11

Attachment C, Section 2 – Use 95% confidence interval for p-value confidence interval per Unified Guidance document.

ATI Response
ATI has updated Attachment C to use a 95 percent confidence interval for the Mann-Kendall analyses in the attached *Farm Ponds Parcels Restoration Completeness Evaluation* (note that UCL calculations used the 95 percent confidence level). Using a 95% confidence interval did not change the conclusions of the RCE for the Farm Ponds Parcels.

EPA Comment #12

The report makes recommendations for wells based upon the evaluations. Where the attainment monitoring phase (AMP) is concluded, future use of the well may include future monitoring to ensure the remedial action in the ROD continues to meet cleanup levels.

ATI Response
ATI will take EPA's comment into consideration but plans to move forward with a decommissioning work plan for the Farm Ponds Parcels.

DEQ Comment #1

Page 5, Footnote 6 indicates that the NPDES wells are NOT shown on Figure 3. According to the legend on Figure 3, NPDES wells are shown on Figure 3. Which NPDES wells are shown on Fig 3 of this document?

ATI Response
Thank you for identifying this error. Figure 3 did show the NPDES wells, which include HW, ND, ND-1, ND-2, NS, ES, RRD, RRS, SD, SS, WD-1, WD-2, and WS. The NPDES wells were removed from Figure 3 in the attached *Farm Ponds Restoration Completeness Evaluation*.

DEQ Comment #2

Two of the quantitative methods appear the same as the semi-quantitative methods. Can you clarify the difference between quantitative and semi quantitative evaluations?

ATI Response

At a high level, the quantitative method uses at least 4 data points in the RPM and at least 8 data points in the AMP to determine if the aquifer has been restored for the constituent/well pair. The semi-qualitative method is used when there isn't sufficient data for the quantitative method because the constituent has not historically been considered a constituent of concern at the well and/or area. The semi-qualitative method uses at least 2 data points to determine if the aquifer has been restored for the constituent/well pair.

DEQ Comment #3

How do the cleanup levels compare to the updates proposed during the annual meeting? Will that change which wells have completed cleanup requirements?

ATI Response

Three constituents in the Farm Ponds Parcels restoration completeness evaluation have/would have updated cleanup levels: beryllium, manganese, and fluoride.

- The cleanup level for beryllium is 1 microgram per liter (µg/L) and the current EPA maximum contaminant level (MCL) is 4 µg/L. The current MCL is used in the Farm Ponds Parcels restoration completeness evaluation. However, all post-remedy monitoring results for beryllium were non-detect with a method reporting limit of 0.5 µg/L or less. Therefore, using the current cleanup level for beryllium of 4 µg/L does not change which wells have completed cleanup requirements.
- The secondary MCL for manganese is listed in the ROD's Table 10-1, which is a nonmandatory water quality guideline for aesthetic (i.e., taste, color, odor) purposes. Table 10-1 notes state that the Safe Drinking Water Act MCLs, nonzero maximum contaminant level goal, or Oregon drinking water standards would apply as a cleanup level. In 2010, the Oregon Environmental Quality Commission revised Oregon's manganese water quality criteria by removing (1) the "water and fish ingestion" criterion and (2) the "fish consumption only" criterion for freshwaters; these changes were approved by EPA in 2011 (DEQ, n.d.). As the ROD manganese cleanup level is based on a non-enforceable secondary MCL and Oregon removed all manganese freshwater fish consumption criteria, ATI understands there is no cleanup level for manganese at the Site. Therefore, using the current cleanup level for manganese does not change which wells have completed cleanup requirements.
- Fluoride's cleanup level in the ROD's Table 10-1 is listed as 2,000 µg/L and the current EPA MCL is 4,000 µg/L. The Site adopted the current fluoride MCL in 2016 with EPA approval, although an explanation of significant differences was not drafted. Using the current cleanup level for fluoride of 4,000 µg/L does not change which wells have completed cleanup requirements.

If you have any questions, please feel free to contact me by phone at 541.812.7230 or by email at Michael.Riley@ATImetals.com.

Sincerely,

Michael Riley
Manager, Environmental Operations & Compliance

Enclosures: 1. *Farm Ponds Parcels Restoration Completeness Evaluation*

References:

EPA. 2014. Recommended Approach for Evaluating Completion of Groundwater Restoration Remedial Actions at a Groundwater Monitoring Well. Office of Solid Waste and Emergency Response OSWER 9283.1-44. U.S. Environmental Protection Agency. August 2014.

EPA. 2021. USEPA Region 10 Comments Project Site: ATI - Teledyne Wah Chang DOCUMENT: ATI's Millersburg Operations Remedial Action Progress Summary for 2020. Prepared by United States Environmental Protection Agency. May 6, 2021.

GSI. 2021. Millersburg Operations Remedial Action Progress Summary Year 2020. Prepared by GSI Water Solutions, Inc. Revised December 2021.

GSI. 2022. Draft Solids Area Restoration Completeness Evaluation. Prepared by GSI Water Solutions, Inc. March 2022.

GSI Water Solutions, Inc.

TECHNICAL MEMORANDUM

Farm Ponds Parcels Restoration Completeness Evaluation

To: Mike Riley – ATI Millersburg Operations

From: Ellen Svadlenak – GSI Water Solutions, Inc.
Matt Kohlbecker – GSI Water Solutions, Inc.
Renee Fowler – GSI Water Solutions, Inc.

CC: Chan Pongkhamsing – U.S. Environmental Protection Agency
Margaret Oscilia– Oregon Department of Environmental Quality

Attachments: Figures 1-4
Attachment A. Geologic Unit Contacts, Depth to Groundwater and Vertical Gradients
Attachment B.1-B.4. Restoration Analysis Data Table and Plots
Attachment C. Technical Documentation for Mann-Kendall Trend Analyses and 95% UCLs
Attachment D. Detected Constituents at the Farm Ponds Parcels

Date: April 15, 2022

This technical memorandum presents an evaluation of restoration completeness at the Farm Ponds Parcels of the Allegheny Technologies Incorporated (ATI) Millersburg Operations (Site) in Millersburg, Oregon. The Farm Ponds Parcels are a subarea within the Farm Ponds Area (Figure 1). The evaluation was conducted in general accordance with the U.S. Environmental Protection Agency (EPA) guidance *Recommended Approach for Evaluating Completion of Groundwater Restoration Remedial Actions at a Groundwater Monitoring Well* (EPA, 2014). The memo is organized as follows:

- Section 1: Background
- Section 2: Methods for Evaluating Restoration Completeness
- Section 3: Results of the Restoration Completeness Evaluation
- Section 4: Conclusions and Recommendations
- Section 5: References

1. Background

In 2019, EPA performed a Remedial Process Optimization Study and published an Optimization Review Report (EPA, 2019). The Optimization Review Report included a useful overview of the Site and several valuable recommendations. In particular, Optimization Recommendation 5.8.1 advocated that ATI use existing EPA attainment guidance for evaluating contaminant concentrations on a well-by-well basis in the South Extraction Area (SEA), Farm Ponds Area, and Solids Area to develop the statistical power required to demonstrate that groundwater cleanup requirements have been met (EPA, 2019)[1]. In order to not duplicate or confuse terminology, the attainment analysis EPA recommended will be called a restoration completeness evaluation (RCE) hereafter in this Technical Memorandum.

[1] The power of a statistical study is how likely the study is to distinguish an actual effect from one of chance (e.g., Helsel and Hirsch, 2002).

This section provides background regarding the RCE and the Farm Ponds Area, including the purpose and objectives of the evaluation (Subsection 1.1), an overview of the ATI Millersburg Operations and Farm Ponds Area (Subsection 1.2), and a conceptual site model (CSM) for the Farm Ponds Area (Subsection 1.3).

1.1 Purpose and Objectives

The purpose of this RCE is to assess on a well-by-well basis whether constituents of concern (COC) concentrations in Farm Ponds Parcels groundwater have been reduced to below cleanup levels, and will remain below cleanup levels in the future. The objectives of the RCE are:

- Identify COCs at the Farm Ponds Parcels based on historical exceedances of groundwater cleanup levels and the Record of Decision (ROD);
- Identify monitoring wells to include in the RCE based on historical exceedances of groundwater cleanup levels at each well; and,
- Determine the remediation phase for each COC at such wells based on EPA guidance (2014) (i.e., evaluate whether each COC at each well is in the Remediation Monitoring Phase [RMP], the Attainment Monitoring Phase [AMP], or Restoration Complete).

1.2 ATI Millersburg Operations and Farm Ponds Area Overview

The Site is approximately 225 acres and is located in the southern portion of Millersburg, Oregon. The Site consists of the Main Plant, which includes the Fabrication and Extraction Areas; the Solids Area; and the Farm Ponds Area (Figure 1). The Farm Ponds Area is located ¾ mile north of the Main Plant (Figure 2) and is subdivided into the Soil Amendment Area and the Farm Ponds Parcels.

- **Soil Amendment Area.** The Soil Amendment Area is the site of a one-time (i.e., 1976) application of lime solids to beneficially amend agricultural soils. The application was performed under a permit from the Oregon Department of Environmental Quality (DEQ) over an area that roughly corresponds with tax lot 00108 in Figure 2 (CH2M Hill, 1993).
- **Farm Ponds Parcels.** The Farm Ponds Parcels were the site of four, 2.5-acre bermed ponds (Figure 3) with mixed soil-bentonite liners, constructed in 1979, that were used to manage lime solids from ATI's Central Wastewater Treatment System (CWTS) (CH2M Hill, 1993; EPA, 1994; EPA, 2008). A slurry of wastewater and lime solids was discharged to the southern end of the ponds. Lime solids settled out of the slurry and were retained in the ponds, while the liquid was recovered on the northern end of the ponds and returned to the CWTS. The Farm Ponds were operated from 1979 to 1993 under a National Pollutant Discharge Elimination System (NPDES) permit issued by the Oregon DEQ[2] (CH2M Hill, 1998; CH2M Hill, 2003). In 1993, ATI stopped using the Farm Ponds Parcels for lime solids management and began managing lime solids at the Main Plant with an advanced solids handling system (CH2M Hill, 2003), and the Farm Ponds were decommissioned by the end of 1999. Currently, most of the Farm Ponds Parcels are vacant, except for a nonhazardous waste interim staging area in the northeast corner of the area.

1.3 Conceptual Site Model for the Farm Ponds Area

In order to characterize contamination associated with the Farm Ponds, ATI collected over 50 soil and lime solids samples and installed 25 monitoring wells. This section presents an abbreviated CSM for the Farm Ponds Area, which includes identification of the source area (Subsection 1.3.1), a high-level overview of the geologic and hydrogeologic setting (Subsection 1.3.2), a discussion of remediation activities (Subsection 1.3.3), and current groundwater quality conditions (Subsection 1.3.4).

[2] Permit No. 100522.

1.3.1 Source Area

The Soil Amendment Area is not considered to be a source of groundwater contamination in the Farm Ponds Area based on depth-discrete soil sampling and leaching analyses by the toxicity characteristic leaching procedure (TCLP) during the Remedial Investigation / Feasibility Study (RI/FS) (CH2M Hill, 1993). Therefore, an RCE will not be performed for the Soil Amendment Area.

Based on sampling of lime solids, soil, and groundwater, the source of the chlorinated volatile organic compounds (CVOCs) in groundwater at the Farm Ponds Parcels is wastewater seepage from the ponds (EPA, 2003) and contaminant leaching from the lime solids in the ponds (CH2M Hill, 1999; CH2M Hill, 1993). Therefore, the source area for CVOCs at the Farm Ponds Parcels is within the footprint of the former ponds.

1.3.2 Geologic and Hydrogeologic Setting

The following sections provide an overview of the geologic and hydrogeologic setting in the Farm Ponds Area. A detailed discussion of the geologic and hydrogeologic setting is provided in the RI/FS (CH2M Hill, 1993).

Geologic Setting

The Site is located in the Willamette Valley, an alluvial plain bounded by volcanic rocks of the Cascade Range to the east and volcanic and marine sedimentary rocks of the Coast Range to the west. Over the course of millions of years, the Willamette Valley has filled with thousands of feet of volcanic deposits and sediments eroded from the Coast Range and Cascade Range (CH2M Hill, 1993; O'Connor et al., 2001). In the Farm Ponds Area, the shallow geologic material is comprised of sedimentary rocks and unconsolidated sedimentary soils. From deepest (oldest) to shallowest (youngest) the units are:

- The **Spencer Formation**, which is a 2,500 feet thick sequence of marine sandstone, siltstone, and mudstone with interbedded volcanic flows and tuffs (Baker, 1988)[3]. The depth to the top of the Spencer Formation at ATI is highly irregular due to an erosional period that occurred after deposition. Within the Farm Ponds Area, the Spencer Formation has been encountered in only one boring at 40 feet below ground surface (bgs)[4].
- The **Blue Clay** was deposited by lakes or rivers, and is found within topographic lows of the Spencer Formation [i.e., the Blue Clay is absent where the Spencer Formation was a topographic high (CH2M Hill, 1993)]. The Blue Clay is encountered in the Farm Ponds Area at depths ranging from about 40 feet to 65 feet bgs.
- The **Linn Gravel** is an alluvial fan deposited by streams draining the Cascade Mountains (CH2M Hill, 1993; Crenna and Yeats, 1994) between about 28,000 and 36,000 years before present (Roberts, 1984).
- The **Willamette Silt** is comprised of fine-grained sediments that settled out of floodwaters that inundated the Willamette Valley over 19,000 years ago (Glenn, 1965; O'Connor et al., 2001). On boring logs in the Farm Ponds Area, the Willamette Silt is comprised as an upper unit (described as a brown silt with occasional thin sand interbeds) and a lower unit (described as a gray silt, clayey silt or clay).

Hydrogeologic Setting

In the Farm Ponds Area, the Spencer Formation and Blue Clay are aquitards, and the Linn Gravel and Willamette Silt are water-bearing units. In Figure 3, monitoring wells with an "A" designation (e.g., PW-108A) are completed in the Linn Gravel, and monitoring wells with an "S" designation (e.g., PW-104S) are completed in the Willamette Silt. Groundwater in the Willamette Silt and Linn Gravel flows towards the Willamette River to

[3] Thickness is near Dallas, Oregon, about 20 miles northwest of Millersburg.
[4] Well RRD, a downgradient well located outside of the Farm Ponds property.

the west-southwest, which is a regional discharge point for groundwater in the Willamette Valley (CH2M Hill, 1993; GSI, 2021). Depth to groundwater in the Farm Ponds Area is provided in Attachment A.

Based on the groundwater flow direction and their location, five monitoring wells in the Farm Ponds Area are upgradient of the source area. In Figure 3, grey circles are used to denote the upgradient wells that monitor background groundwater quality (called "background wells") and white circles are used to denote downgradient wells that monitor groundwater impacts from the former Farm Ponds.

1.3.3 Remediation Activities at the Farm Ponds Parcels

ATI has actively remediated contamination in the Farm Ponds Parcels, under EPA oversight, by source removal. Between 1995 and 1999, ATI removed an estimated 62,000 tons of lime solids from the Farm Ponds Parcels and disposed of the solids at the Columbia Ridge Landfill in Arlington, Oregon. The berms were pushed in, the area was regraded, and fencing was installed around the footprint of the former ponds to restrict access (CH2M Hill, 1998; CH2M Hill, 2003; EPA, 2008). Groundwater has not been actively remediated at the Farm Ponds Parcels because the ROD only calls for groundwater extraction in areas of the Site where contaminant concentrations exceed lifetime cancer risk levels of 10^{-4} and/or substantially exceed the non-cancer hazard index of 1 for worker exposure (EPA, 1994). Thus remediation activities were completed by the end of 1999.

1.3.4 Current Groundwater Quality Conditions

Groundwater quality results at Farm Ponds Parcels monitoring wells are provided in Attachment B [5]. Note that groundwater quality results are only shown for a well if the constituent exceeded the cleanup level in one or more samples. Cleanup level exceedances have occurred in 5 of the 20 downgradient monitoring wells at the Farm Ponds Parcels (PW-40A, PW-40S, PW-43S, PW-44S, and PW-104S).

2. Methods for Evaluating Restoration Completeness

This section summarizes the methods for identifying COCs to include in the RCE (Subsection 2.1), selecting the wells to include in the RCE (Subsection 2.2), and determining the phase of remediation for each COC at each well (Subsection 2.3).

2.1 Methods for Identification of COCs

At the Farm Ponds Parcels, groundwater quality samples have been analyzed for numerous constituents over the past 30 years, including volatile organic compounds, semi-volatile organic compounds, metals, radionuclides, and general geochemical parameters. This RCE was conducted for the Farm Ponds Parcels' COCs. COCs were identified as constituents that exceeded a cleanup level in one or more samples during groundwater monitoring from 1989 to 2021, and constituents in the ROD. If a constituent was listed in the ROD but did not exceed the cleanup level, then it was not formally evaluated.[6]

Constituents in the Farm Ponds Parcels groundwater that are not COCs (i.e., those that have always been below cleanup levels) are called "characterization constituents." Because concentrations of these

[5] Note that NPDES compliance wells and background wells are not included in the RCE. See Figure 3 for well locations and Section 2.2 for discussion.

[6] The Operable Unit 2 ROD Table 10-1 based the cleanup level for manganese on the secondary maximum contaminant level (MCL; EPA, 1994), which is a nonmandatory water quality guideline for aesthetic (i.e., taste, color, odor) purposes. Table 10-1 notes state that the Safe Drinking Water Act MCLs, nonzero maximum contaminant level goal, or Oregon drinking water standards would apply as a cleanup level. In 2010, the Oregon Environmental Quality Commission revised Oregon's manganese water quality criteria by removing (1) the "water and fish ingestion" criterion and (2) the "fish consumption only" criterion for freshwaters; these changes were approved by EPA in 2011 (DEQ, n.d.). As the OU2 ROD manganese cleanup level is based on a non-enforceable secondary MCL and Oregon removed all manganese freshwater fish consumption criteria, ATI understands there is no cleanup level for manganese at the Site.

constituents have never exceeded a cleanup level, this RCE assumes that the remediation phase for characterization constituents is "restoration complete" and, therefore, no further evaluation is required.

2.2 Methods for Identification of Wells to Include in Evaluation of Restoration Completeness

EPA's *Guidance for Evaluating Completion of Groundwater Restoration Remedial Actions* recommends evaluation of COC concentrations on a well-by-well basis (EPA, 2013). Wells that have a detection of one or more COCs above cleanup levels are included in the RCE; evaluation of restoration completeness is performed for those constituents at these wells. Wells that have never had a COC detection above cleanup levels are called "characterization wells"; this RCE assumes that the remediation phase for characterization wells is "restoration complete" and, therefore, no further action is required.

Note that the following types of wells at the Farm Ponds Parcels, shown in Figure 3, are not included in the RCE:

- **NPDES Compliance Wells.** The NPDES compliance wells were installed around the Farm Ponds in the late 1970s or early 1980s for the purpose of evaluating compliance with ATI's NPDES permit[7]. The wells are not included in the RCE because groundwater samples from the wells may not be representative of conditions in the Willamette Silt and Linn Gravel. Specifically, well construction of the NPDES compliance wells does not meet Oregon Water Resources Department standards for monitoring wells, and/or the actual well construction does not match the reported well construction on the driller's log for the well[8]. Moreover, it is not necessary to include the NPDES compliance wells in an RCE because the 25 properly-constructed monitoring wells provide sufficient coverage to characterize groundwater conditions at the Farm Pond Parcels (see Figure 3). It is important to note that CVOC concentrations at now-decommissioned NPDES compliance wells SS and SD historically exceeded cleanup levels; these wells were replaced with monitoring wells PW-104S and PW-108A in 2015, which are included in this RCE.
- **Background Monitoring Wells.** The background monitoring wells (denoted by grey-filled circles in Figure 3) are located upgradient of the source area in the Farm Ponds Parcels and, therefore, are not included in the RCE.

2.3 Methods to Determine Remediation Phase and Restoration Completeness

EPA guidance for evaluating whether groundwater restoration is complete recommends assigning a phase to each COC at each well (i.e., the RMP, AMP, or restoration complete). The RMP occurs while ". . . either active or passive remedial activities are being implemented to reach groundwater cleanup levels . . ." (EPA, pg. 2, 2014), and is completed when the data demonstrate that a COC has reached the cleanup level. The AMP ". . . occurs after . . . the RMP is complete . . . [and] typically is complete when contaminant-specific data provide a technical and scientific basis that: (1) [t]he contaminant cleanup level for each COC has been met; <u>and</u> (2) [t]he groundwater will continue to meet the contaminant cleanup level for each COC in the future" (EPA, pg. 2, 2014). Restoration is considered to be complete at the end of the AMP.

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[7] The NPDES wells are not shown on Figure 3. The wells were installed on the north, east, south, and west sides of the ponds, and were completed as pairs in shallow and deep horizons (e.g., well "NS" and well "ND" were located on the north side of the Farm Ponds parcels, with "NS" being completed in a shallow water-bearing zone and "ND" being completed in a deep water-bearing zone). Figure 3 of GSI (2021) shows the locations of the NPDES wells.

[8] For example, according to the well log, NPDES well SS (LINN 5119) was sealed from ground surface to 2 feet below ground surface (bgs) [which does not meet the current requirements as stated in Oregon Administrative Rules (OAR) 690-240] and was screened from 7 feet bgs to 12 feet bgs. When NPDES well SS was decommissioned in September 2012, it was found to have no seal and no screen (GSI, 2013). In addition, the RI/FS states that wells ES and RRS do not have adequate surface seals (CH2M Hill, pg. 3-42, 1993).

Each COC at each well that is subject to the RCE is assigned to a remediation phase (i.e., RMP, AMP, or restoration complete) using quantitative or semi-quantitative methods:

- **Quantitative Methods.** COCs at the Farm Ponds Parcels that have been regularly sampled and have detection limits below their respective cleanup levels were evaluated for remediation phase using the quantitative method in EPA guidance (2014), as described below.

  Criteria for the End of the RMP
  The RMP continues until there are a minimum of four consecutive analytical results below the cleanup level following: (1) completion of remediation *or* (2) a detection above the cleanup level (whichever is more recent). For example, more than four analytical results were used during the RPM for fluoride at monitoring well PW-18B in the *Draft Solids Area Restoration Completeness Evaluations* because the results were occasionally above the cleanup level (GSI, 2022). Note that non-detect analytical results with a method reporting limit exceeding the cleanup level are not counted as being “below the cleanup level.”

  Criteria for the End of the AMP
  The AMP is evaluated using a minimum of eight analytical results. If there are more than eight analytical results available for the AMP (i.e., after the RMP ended), then the earliest eight analytical results are used to make a conclusion about ending the AMP and subsequent analytical results are evaluated to determine if they put the conclusion to end the AMP in question. If there are fewer than eight (specifically, between 4 and 7) analytical results, then the most recent analytical results from the RMP are used for the AMP evaluation to increase the dataset size to eight results. Additionally, non-detect analytical results with a method reporting limit exceeding the cleanup level are not included in the AMP analysis and extends the AMP dataset beyond 8 data points.

  Conclusions about the end of the AMP for each COC/well pair are made by reviewing data tables (if all eight analytical results are non-detect) or time series plots (if one or more of the eight analytical results is a detection). A least squares regression line is added to a plot if at least three of the eight analytical results are detections, with the method reporting limit being used for non-detect data points, if applicable. Statistical analysis is used if the regression line is not conclusive.

  The AMP is considered to be ongoing for a COC/well pair if:

  - Based on a visual analysis of the time series plot, concentrations exhibit an upward trend during the AMP.

  The AMP is considered to have ended for a COC/well pair if one of the three following conditions is met:

  - All eight analytical results during the AMP are below method reporting limits.
  - Based on a visual analysis of the time series plot, concentrations exhibit a *clear* downward trend during the AMP (if there are enough detections to create a trend line) or do not exhibit evidence of increasing concentrations (if there are not enough detections to create a trend line)[9].
  - The trend is not clear, but the 95 percent upper confidence limit (UCL) of the mean is below the cleanup level and a Mann-Kendall trend test indicates COC concentrations exhibit either no evidence of a statistically significant trend or evidence of a statistically significant downward trend.

[9] Trend lines were created for datasets with three or more detections. Trend lines were not created for datasets with two or fewer detections.

EPA Pro UCL Version 5.1 software is used to calculate the 95% UCL of the mean and perform a Mann-Kendall statistical test. The Mann-Kendall test is performed at a level of significance of α=0.05 and a confidence interval of 95 percent. Technical documentation of the methods used for the Mann Kendall trend analysis are summarized in Attachment C.

- **Semi-Quantitative Methods.** If the groundwater quality data are insufficient to evaluate restoration completeness in accordance with the procedures in EPA guidance (2014), restoration completeness may be evaluated using a semi-quantitative method, if appropriate. Data are "insufficient" if the COCs are rarely sampled or if the method reporting limit is consistently above the cleanup level, as follows.:
    - Groundwater Quality Data Are Insufficient Because COCs Are Rarely Sampled. Some COCs exceed a cleanup level during early sampling (i.e., from 1989 to 1991) but are not regularly sampled in subsequent years because EPA and ATI did not consider these COCs to be a driver for cleanup at the Farm Ponds Parcels. For these COCs, groundwater quality data are insufficient to apply the quantitative procedures in EPA guidance (2014). The semi-quantitative RCE may be performed if there are two or more data points after remedy implementation concluded in 1999.

      Restoration is considered to be complete for a COC/well pair if one of the three following conditions is met:

        - At least two analytical results after remedy implementation or the most recent cleanup level exceedance (whichever is more recent) are below the method reporting limit or are significantly below the cleanup level.
        - Based on a visual analysis of the time series plot, concentrations exhibit a *clear* downward trend after remedy implementation (if there are enough detections to create a trend line) or do not exhibit evidence of increasing concentrations (if there are not enough detections to create a trend line)[10].
        - The trend is not clear, but the 95 percent upper confidence limit (UCL) of the mean is below the cleanup level and a Mann-Kendall trend test indicates COC concentrations exhibit either no evidence of a statistically significant trend or evidence of a statistically significant downward trend.
    - Groundwater Quality Data Are Insufficient Because COCs Have Elevated Detection Limits Relative to their Cleanup Level. For 1,1,2,2-TCA, the laboratory detection limits are not sufficiently low to evaluate restoration completeness in accordance with EPA guidance (2014) because the cleanup level of 0.175 μg/L is lower than the detection limit of 0.25 μg/L (see Attachment B.1). 1,1,2,2-TCA was not used at the Site, and its presence in groundwater is attributable to the fact that 1,1,2,2-TCA is an intermediate in the production of PCE, TCE, and 1,2-DCE, and may occur as an impurity in the final chemical products (Kapp, 2014; EPA, 2000). Because all four compounds (1,1,2,2-TCA, PCE, TCE, and 1,2-DCE) are characterized by a similar tendency to sorb to soil grains and, therefore, mobility in soil and groundwater[11], we expect that 1,1,2,2-TCA would continue to be associated with PCE, TCE and 1,2-DCE during subsurface transport. Given the close association of 1,1,2,2-TCA with PCE, TCE and 1,2-DCE in the subsurface, the semi-quantitative RCE would conclude that restoration is complete for 1,1,2,2-TCA at a well when there have been no detections of 1,1,2,2-TCA above the cleanup

[10] Trend lines were created for datasets with three or more detections. Trend lines were not created for datasets with two or fewer detections.

[11] For organic compounds, the propensity of a chemical to sorb to soil grains is governed by the organic carbon-water partitioning coefficient (K_{oc}). The geometric K_{oc} of 1,1,2,2-TCA is 79 liters per kilogram (L/kg), which is similar to the K_{oc} of TCE (94 L/kg), PCE (265 L/kg), and 1,2-DCE (40 L/kg). [Note: K_{oc} values for 1,1,2,2-TCA, TCE, and PCE are from Table 38 of EPA (1996). The K_{oc} value for 1,2-DCE is from PubChem (2021)].

level for 12 events (four for the RMP and 8 for the AMP) and restoration is complete for PCE, TCE and 1,2-DCE at the same well.

3. Results of the Restoration Completeness Evaluation

This section presents the results of the RCE at the Farm Ponds Parcels, and includes identification of COCs (Subsection 3.1); identification of characterization wells, background wells, and wells that are the subject of the restoration evaluation (Subsection 3.2); and determination of remediation phase (i.e., RMP, AMP, or restoration completeness) (Subsection 3.3).

3.1 Constituents of Concern

A total of 58 constituents have been detected in groundwater at the Farm Ponds Parcels, including naturally-occurring and anthropogenic constituents. A list of the 58 detected constituents is provided in Attachment D. Ten of the 58 constituents exceed the cleanup level in one or more samples collected from 1989 to 2021 and, therefore, are considered to be COCs at the Farm Ponds Parcels. The COCs include:

- **Chlorinated volatile organic compounds** trichloroethene (TCE); tetrachloroethene (PCE); vinyl chloride (VC); 1,1,2-trichloroethane (TCA); 1,1,2,2-tetrachloroethane (TCA); 1,2-dichloroethane (DCA); and 1,1-dichloroethene (DCE).
- **Metals** arsenic (total), beryllium (total), and chromium (total).

3.2 Background Wells, Characterization Wells and Wells for Evaluating Restoration Completeness

As discussed in Subsection 2.2, monitoring wells located upgradient of the source area are considered background monitoring wells (specifically PW-35A, PW-36A, PW-37A, PW-38A, and PW-39A). Restoration is considered to be complete at these 5 wells, so they were not included in this RCE. Table 1 shows the remaining 20 monitoring wells at the Farm Ponds Parcels and the COCs in Farm Ponds Parcels groundwater, with an "X" denoting a COC that exceeds a cleanup level during sampling from 1989 to 2021. Fifteen of the monitoring wells have never had an exceedance of a COC and are considered to be characterization wells (gold-highlighted wells in Table 1); restoration is considered to be complete at these fifteen wells. The remaining five wells exceeded a cleanup level for at least one COC, and an evaluation of restoration completeness was performed for those constituents at these wells using quantitative and semi-quantitative methods. Background wells, characterization wells, and non-characterization wells (i.e., wells that were evaluated for restoration completeness) are shown in Figure 4.

Table 1. Monitoring and Characterization Wells in the Farm Ponds

COCs	PW-40A	PW-40S	PW-41A	PW-43A	PW-43S	PW-44A	PW-44S	PW-64A	PW-64S	PW-65A	PW-65S	PW-66A	PW-66S	PW-67A	PW-67S	PW-104S	PW-105S	PW-106S	PW-107S	PW-108A
Chlorinated Volatile Organic Compounds (CVOCs)																				
Trichloroethene (TCE)	X	X														X				
Tetrachloroethene (PCE)	X	X														X				
Vinyl Chloride (VC)	X	X																		
1,1,2-Trichloroethane (TCA)	X	X														X				
1,1,2,2-Tetrachloroethane (TCA)	X	X																		
1,2-Dichloroethane (DCA)	X	X														X				
1,1-Dichloroethene (DCE)		X																		
Metals (Total)																				
Arsenic							X													
Beryllium	X	X			X															
Chromium					X															

Notes
X = COC has exceeded the cleanup level
Gold Well ID = a characterization well, where no COCs have exceeded the cleanup level
White Well ID = COCs have exceeded the cleanup level; restoration completeness will be evaluated

3.3 Evaluation of Restoration Completeness

This section presents a quantitative (Subsection 3.3.1) and semi-quantitative (Subsection 3.3.2) evaluation of restoration completeness at the Farm Ponds Parcels. Table B.1 shows the groundwater quality data that were collected at non-characterization wells in the Farm Ponds Parcels.

3.3.1 Quantitative Restoration Completeness Evaluation According to EPA Guidance (2014)

The results of the quantitative RCE are summarized in Table 2 and the following paragraphs.

Table 2. Quantitative Restoration Completeness Evaluation.

Well ID	COC	RMP End Date	AMP End Date	Rationale for AMP Ending	Evaluation of Post-AMP Data
PW-40A	PCE TCE 1,1,2-TCA 1,2-DCA	Spring 2001*	Spring or Fall 2007	All COCs have either a downward concentration trend during the AMP (see time series plot for 1,2-DCA in Attachment B.2), or COCs were not detected during the AMP (PCE; TCE; 1,1,2-TCA) (see Attachment B.1).	All post-AMP samples are ND or significantly below cleanup levels; therefore, post-AMP samples do not change the conclusion that the AMP has ended.
	VC	Fall 2005†	Spring 2016	Concentration trend during the AMP is downward (see time series plot for VC in Attachment B.2).	N/A
PW-40S	PCE	Spring 2001*	Fall 2007	Concentration trend during the AMP is downward [see time series plot for PCE in Attachment B.3(b)].	All post-AMP samples are ND or significantly below the cleanup level and do not appear to exhibit a trend; therefore, post-AMP samples do not change the conclusion that the AMP has ended.
	TCE	Fall 2006†	Spring 2015	Concentration trend during the AMP was not clear. Mann-Kendall trend analysis indicates that there is statistically significant evidence of a decreasing trend at the 95 percent confidence interval, and that the 95 percent UCL concentration of the mean (0.805 µg/L) is below the cleanup level (5 µg/L) [see time series plot for TCE in Attachment B.3(b)].	All post-AMP samples are significantly below cleanup levels and do not appear to exhibit a trend; therefore, post-AMP samples do not change the conclusion that the AMP has ended.
	VC	Fall 2012†	Spring 2019	No evidence of increasing concentrations during the AMP (insufficient number of detections for a trend analysis) [see time series plot for VC in Attachment B.3(b)].	N/A
	1,1-DCE 1,1,2-TCA	Spring 2001*	Spring 2007	For 1,1-DCE, concentration trend during the AMP is downward. For 1,1,2-TCA, there is no evidence of an increasing trend (insufficient number of detections for a trend analysis) [see time series plots in Attachment B.3(a) and B.3(b)].	All post-AMP samples are ND or significantly below cleanup levels and do not appear to exhibit a trend; therefore, post-AMP samples do not change the conclusion that the AMP has ended.
	1,2-DCA	Fall 2002†	Fall 2010	Concentration trend during the AMP is downward [see time series plot for 1,2-DCA in Attachment B.3(a)].	All post-AMP samples are ND or significantly below cleanup levels and do not appear to exhibit a trend; therefore, post-AMP samples do not change the conclusion that the AMP has ended.
PW-104S	PCE TCE 1,1,2-TCA 1,2-DCA	N/A	N/A	RMP is ongoing [see time series plots in Attachment B.4]	N/A

Notes

AMP = Attainment Monitoring Phase
DCA = dichloroethane
DCE = dichloroethene
N/A = not applicable
RMP = Remediation Monitoring Phase
PCE = tetrachloroethene
TCA = trichloroethene
µg/L = micrograms per liter
ND = non-detect
TCE = trichloroethene
VC = vinyl chloride

* 4 events after completion of remediation
† 4 events after a detection above the cleanup level

COCs PCE; TCE; 1,1-DCE; VC; and 1,2-DCA were regularly sampled from 1989 to 2021 and method reporting limits are below their respective cleanup levels. Therefore, sufficient data exists to conduct a quantitative RCE in accordance with EPA guidance (2014). Attachment B presents an analysis of remediation phase (i.e., RMP, AMP, or restoration complete) for each COC/well pair.

- Attachment B.1 is a table showing groundwater quality data that were used to evaluate the remediation phase. The peach highlighting indicates a COC is in the RMP, the blue highlighting indicates a COC is in the AMP, and the green highlighting indicates that restoration is complete for a

COC at a well. Cells with a peach to blue color fade and underlined numbers indicate that data from the RMP are used to achieve the eight data points required for evaluation of the AMP.

- Attachment B.2 (PW-40A), Attachment B.3 (PW-40S), and Attachment B.4 (PW-104S) are time series plots of CVOC concentration versus time that were used to evaluate COC concentration trends.

At the Farm Ponds Parcels, the start and end of the RMP was identified based on a visual analysis of the data table. The end of the AMP was identified based on a visual analysis of the data table (if all COC concentrations were non-detect), a visual analysis of time series plots (if at least one COC was detected during the AMP) or a Mann-Kendall statistical trend analysis (PW-40S for TCE). As explained in the "Rationale for AMP Ending" and "Evaluation of Post-AMP Data" columns in Table 2, we conclude that the AMP has ended (i.e., restoration has been completed) for all COCs at monitoring wells PW-40A and PW-40S, and that restoration is incomplete at monitoring well PW-104S for PCE; TCE; 1,1,2-TCA; and 1,2-DCA.

3.3.2 Semi-Quantitative Restoration Completeness Evaluation

The white-filled cells in Table B.1 indicate COC/well pairs that are subject to a semi-quantitative RCE. Semi-quantitative RCEs were performed for three COCs due to insufficient data collected between 1989 and 2021 (arsenic, beryllium and chromium) and for one COC due to the detection limit being above the cleanup level (1,1,2,2-TCA). Table 3 presents a summary of the available groundwater quality data for these three COCs.

Table 3. Semi-Quantitative Evaluation of Restoration Completeness.

Constituent	Notes
Arsenic (total)	At PW-44S, arsenic was detected slightly above the cleanup level of 10 μg/L in 1991. The next time PW-44S was sampled, in 2016 and 2022, arsenic was detected at 4.75 and 4.45 μg/L respectively, below the cleanup level of 10 μg/L.
Beryllium (total)	Beryllium was detected above the cleanup level of 4 μg/L in PW-40S, PW-40A, and PW-43S during sampling from 1989 to 1991. The next time these wells were sampled, in 2016 and 2022, beryllium was not detected in any of the wells (method reporting limit of 0.1 and 0.5 μg/L respectively).
Chromium (total)	At PW-43S, chromium was detected above the cleanup level of 100 μg/L in 1991. The next time PW-43S was sampled, in 2016 and 2022, chromium was detected at 5.05 and 5.61 μg/L respectively, significantly below the cleanup level of 100 μg/L.
1,1,2,2-TCA	1,1,2,2-TCA was detected above the cleanup level of 0.175 μg/L in PW-40S and PW-40A in 1990 and 1996, respectively, and that there have been no detections above the method reporting limit since 1996 (which ranges from 0.25 μg/L to 5 μg/L).

Notes

μg/L = micrograms per liter

Semi-Quantitative Restoration Completeness Evaluation for Arsenic, Beryllium, and Chromium

As discussed in Table 3, concentrations of arsenic, beryllium and chromium were significantly lower in 2016 and 2022 than in 1989 to 1991, which suggests that the data from 1989 to 1991 are not representative of current conditions. With two data points from 2016 and 2022, we conclude that restoration is complete for arsenic, beryllium, and chromium at the Farm Ponds Parcels (see Attachment B.1).

Semi-Quantitative Restoration Completeness Evaluation for 1,1,2,2-TCA

As discussed in Table 3, concentrations of 1,1,2,2-TCA have been below the method reporting limit since 1996 at PW-40A (during 21 sampling events) and since 1991 at PW-40S (during 32 sampling events). Recall that 1,1,2,2-TCA is closely associated with PCE, TCE and 1,2-DCE in the subsurface, and that we assume restoration is complete for 1,1,2,2-TCA at a well when restoration is complete for PCE, TCE and 1,2-DCE.

Because (1) 1,1,2,2-TCA has not been detected for 12 or more events, and (2) restoration is complete for PCE, TCE, and 1,2-DCE at the wells where 1,1,2,2-TCA is a COC (PW-40A and PW-40S, see Attachment B.1)[12], we conclude that restoration is complete for 1,1,2,2-TCA at the Farm Ponds Parcels. Note that 1,2-DCE is a characterization constituent (i.e., not a COC) at the Farm Ponds Parcels and, therefore, is not included in Attachment B.1.

4. Conclusions and Recommendations

A summary of the results of the RCE at the Farm Ponds Parcels (including the semi-quantitative and quantitative evaluations) is provided in Table 4 below. Based on the analysis in this technical memorandum, the following conclusions and recommendations about groundwater restoration in the Farm Ponds Parcels and future groundwater sampling can be made:

- **Continued Monitoring for CVOCs.** Monitoring well PW-104S is in the RMP for CVOCs. We recommend to continue sampling monitoring well PW-104S annually for the EPA Method 8260 list to evaluate concentration trends and the progress of monitored natural attenuation. In addition, we recommend sampling characterization monitoring well PW-64S every five years for the EPA Method 8260 list to confirm protectiveness of the remedy at the property boundary [monitoring well PW-64S is downgradient of monitoring well PW-104S, as shown by the groundwater elevation contours in Figure 4 of the *Farm Ponds Area Remedial Action Progress Summary Year 2020* report (GSI 2021)].
- **Discontinuing of Sampling and Well Decommissioning.** We recommend discontinuing sampling and decommissioning the following wells where the well is a characterization well, or the well is a background well:
    - The following wells which are background wells: PW-35A, PW-36A, PW-37A, PW-38A, and PW-39A.
    - The following wells which are characterization wells: PW-40A, PW-40S, PW-41A, PW-43A, PW-43S, PW-44A, PW-44S, PW-64A, PW-65A, PW-65S, PW-66A, PW-66S, PW-67A, PW-67S, PW-105S, PW-106S, PW-107S, and PW-108A.

  PW-64S is not proposed for decommissioning because it will be sampled in the future to confirm protectiveness of the remedy at the property boundary (see first bullet above for discussion).
- **Decommissioning Work Plan.** Upon EPA's approval of this RCE, ATI will develop and submit a work plan to EPA for decommissioning the monitoring wells listed above.

[12] In PW-40S, restoration has been complete for PCE, TCE, and 1,2-DCE since 2007, 2015, and 1989, respectively (1,2-DCE is a characterization constituent). In PW-40A, restoration has been complete for PCE, TCE, and 1,2-DCE since 2007, 2007, and 1989, respectively (1,2-DCE is a characterization constituent).

Table 4. Restoration Completeness Evaluation (Including Semi-Quantitative and Quantitative Analyses)

Well ID	Result of Restoration Completeness Evaluation: Remediation Monitoring Phase Incomplete for One or More COCs	Result of Restoration Completeness Evaluation: Restoration Complete for All COCs	Notes
PW-40A		X	
PW-40S		X	
PW-41A		X	
PW-43A		X	
PW-43S		X	
PW-44A		X	
PW-44S		X	
PW-64A		X	
PW-64S		X	
PW-65A		X	
PW-65S		X	
PW-66A		X	
PW-66S		X	
PW-67A		X	
PW-67S		X	
PW-104S	X		**Still in Remediation:** PCE; TCE; 1,1,2-TCA; 1,2-DCA
PW-105S		X	
PW-106S		X	
PW-107S		X	
PW-108A		X	

Notes

COC = Constituent of Concern
TCA = trichloroethene
TCE = Trichloroethene
DCA = dichloroethane
PCE = tetrachloroethene

NOTE: Background wells (PW-35A, PW-36A, PW-37A, PW-38A, and PW-39A) and NPDES compliance wells are not shown in the table because they were not included in the RCE.

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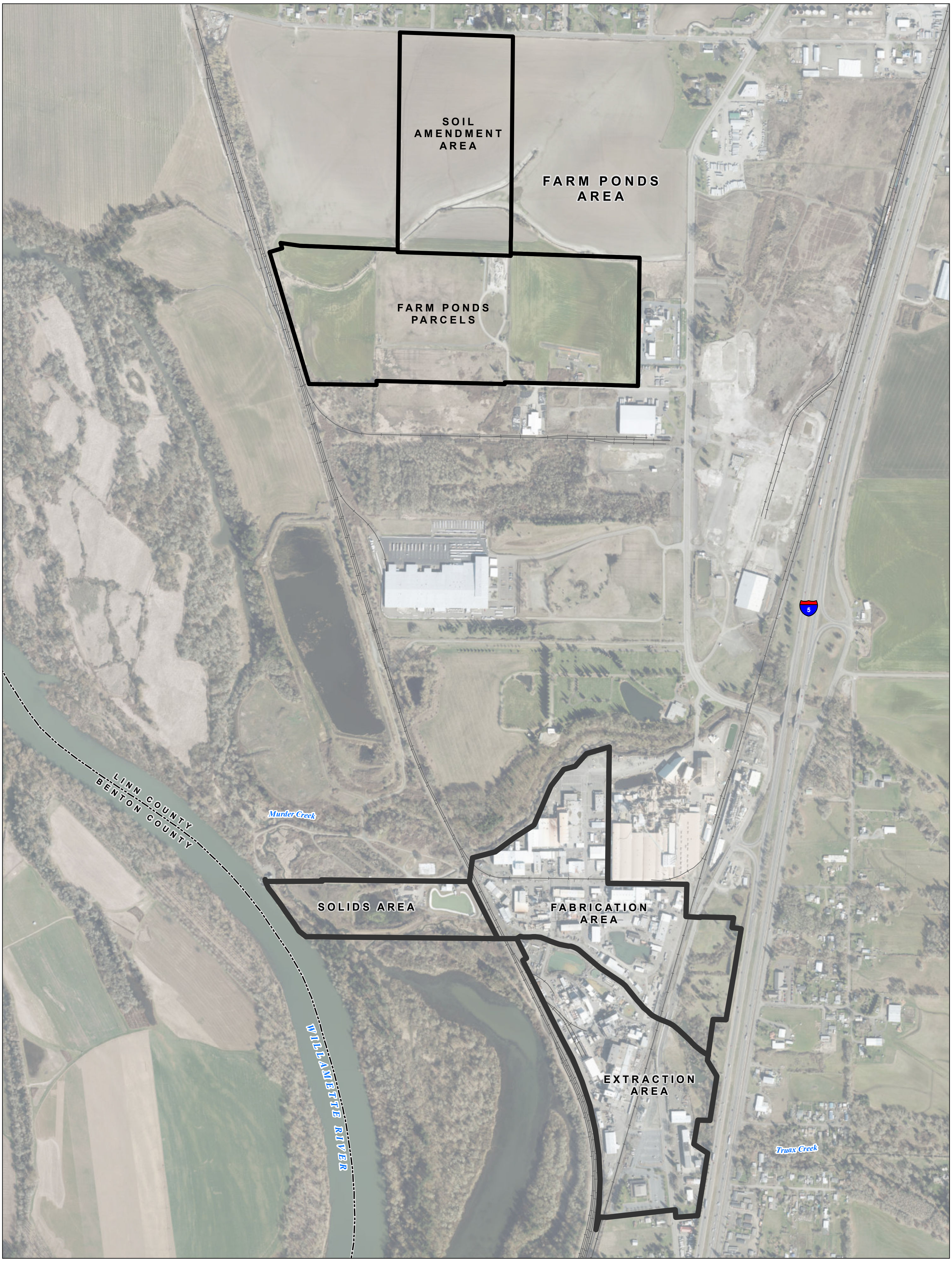
Figures



LEGEND

Property Boundary

Railroad

County Boundary

FIGURE 1

Millersburg Operations

ATI Millersburg Operations, Oregon

N

0 400 800 1,200

Feet

GSI Water Solutions, Inc.

Date: December 15, 2021
Data Sources: OGIC, USGS, GeoTerra Imagery (2019)

Document Path: Y:\0168_Wah_Chang\Source_Figures\034_2021_2022\Restoration_Comp_Eval\Farm_Ponds\Figure1_Millersburg_Operations.mxd

FIGURE 2

Farm Ponds Parcels Location Map

ATI Millersburg Operations, Oregon

LEGEND

- Site Area
- Farm Ponds Tax Lot
- Railroad

N

0 200 400 600
Feet

Date: December 15, 2021
Data Sources: Linn Co., OGIC, USGS, GeoTerra Imagery (2019)

GSI Water Solutions, Inc.

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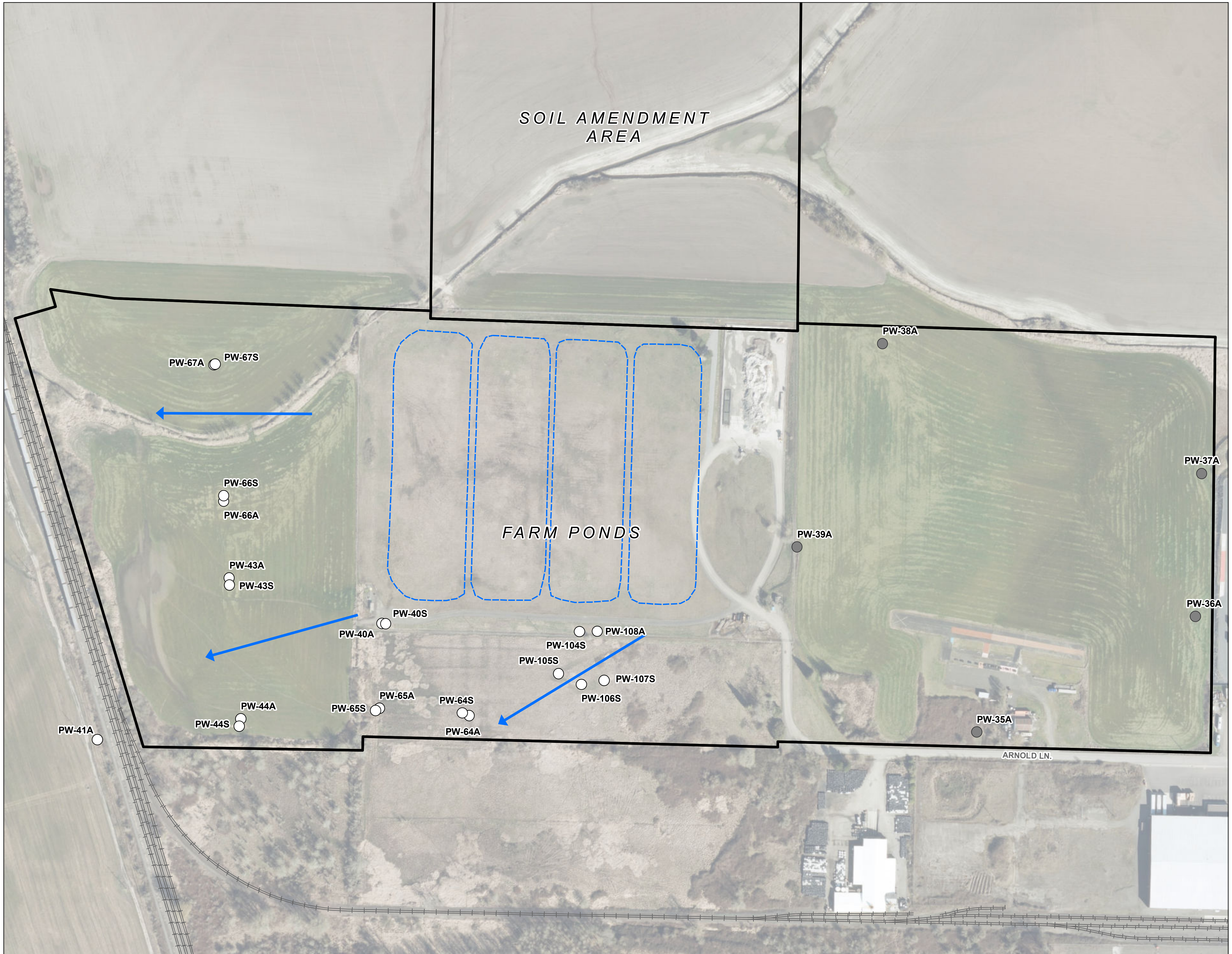

FIGURE 3

Farm Ponds Area Monitoring Wells

ATI Millersburg Operations, Oregon

LEGEND

Groundwater Flow Direction

Monitoring Well

Characterization/Non-Characterization Well

Background Well

All Other Features

Approximate Location of Former Farm Ponds

Property Boundary

Railroad

NOTES

NPDES compliance wells (i.e., NS, ND, ES, HW, WD-1, WD-2, WS, ND-1, ND-2, SS, SD, RRD, RRS) are not shown.

RCE: Restoration Completeness Evaluation

N

0 125 250 375

Feet

Date: April 7, 2022

Data Sources: Wah Chang, City of Albany GIS, GeoTerra Imagery (2019)

GSI Water Solutions, Inc.

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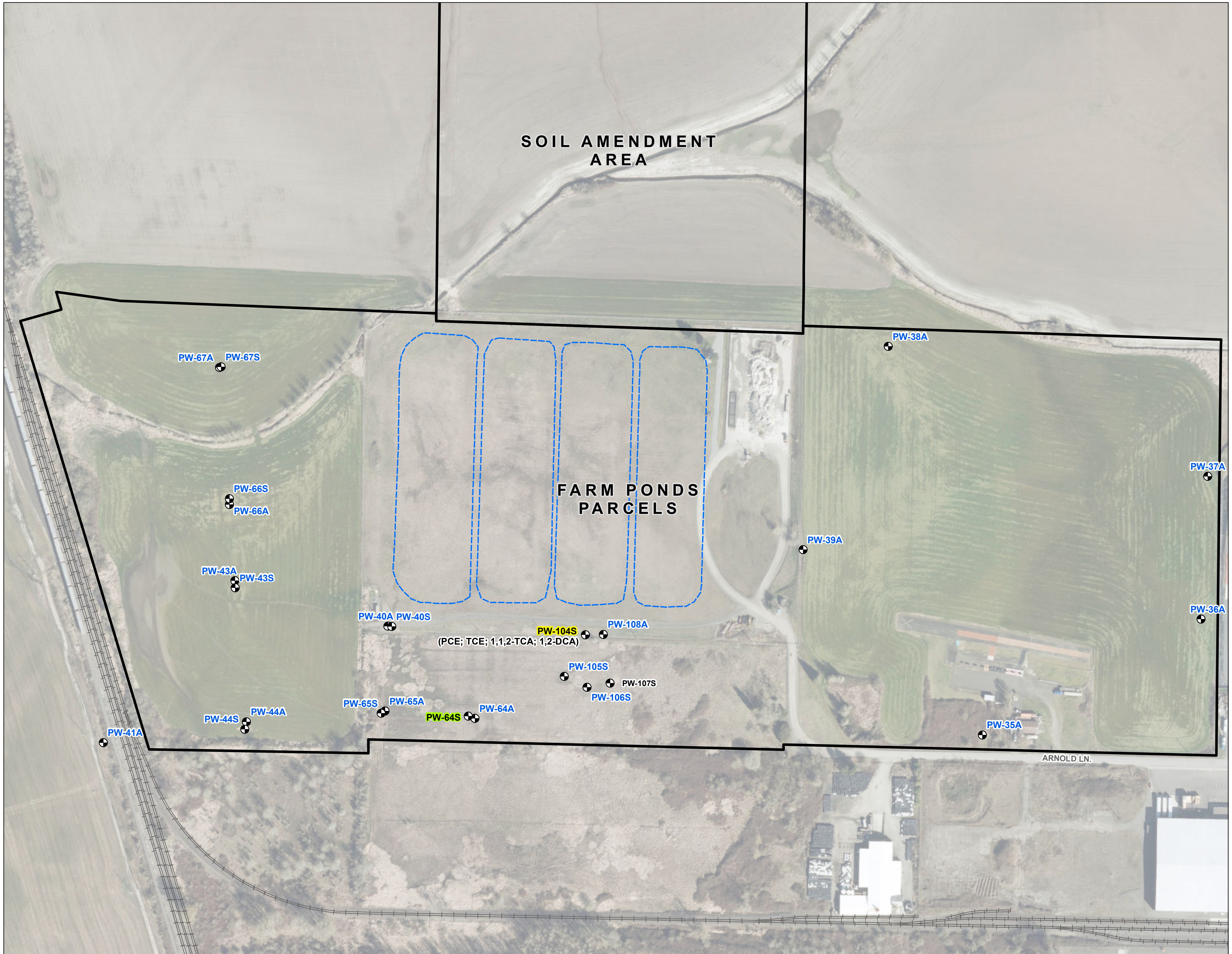


FIGURE 4

Restoration Completeness Evaluation Results

ATI Millersburg Operations, Oregon

LEGEND

Monitoring Well Status

PW-38A Restoration Complete, Decommission

PW-64S Restoration Complete, Sample Every 5 Years

PW-104S Restoration Incomplete, Continue Sampling (COCs in parenthesis have not been restored)

All Other Features

Approximate Location of Former Farm Ponds

Property Boundary

Railroad

NOTES

NPDES compliance wells (i.e., NS, ND, ES, HW, WD-1, WD-2, WS, ND-1, ND-2, SS, SD, RRD, RRS) are not shown.

COCs: Constituents of Concern
DCA: Dichloroethane
PCE: Tetrachloroethene
RCE: Restoration Completeness Evaluation
TCE: Trichloroethene

N

0 125 250 375
Feet

Date: April 8, 2022
Data Sources: Wah Chang, City of Albany GIS, GeoTerra Imagery (2019)

GSI Water Solutions, Inc.

Document Path: Y:\0168_Wah_Chang\Source_Figures\034_2021_2022\Restoration_Comp_Eval\Farm_Ponds\Figure4_Results_Farm_Ponds.mxd

ATTACHMENT A

Geologic Unit Contacts, Depth to Groundwater, and Vertical Gradients at the Farm Ponds Parcels

Attachment A. Depth to Groundwater and Vertical Gradients at the Farm Ponds Parcels.

Farm Ponds Parcels Restoration Completeness Evaluation

Site Information			Water Levels			Screen Information			Vertical Gradients	
Well Cluster	Well	Hydrogeologic Unit	Date	Depth to Groundwater (feet below TOC)	Groundwater Elevation (feet amsl)	Screen Top (feet amsl)	Screen Bottom (feet amsl)	Screen Midpoint (feet amsl)	Vertical Gradient (feet/foot)	Direction
PW-40	PW-40S	Willamette Silt	4/13/2016	5.10	212.41	204.5	199.5	202.0	-0.21	Downward
	PW-40A	Linn Gravel	4/23/2016	9.32	207.85	185.5	175.5	180.5		
PW-43	PW-43S	Willamette Silt	4/13/2016	4.55	209.80	201.4	196.4	198.9	-0.17	Downward
	PW-43A	Linn Gravel	4/13/2016	7.75	206.37	184.1	174.1	179.1		
PW-44	PW-44S	Willamette Silt	4/12/2016	4.66	209.78	202.7	197.7	200.2	-0.17	Downward
	PW-44A	Linn Gravel	4/12/2016	7.29	207.11	189.4	179.4	184.4		
PW-64	PW-64S	Willamette Silt	4/19/2016	3.24	209.72	203.1	193.1	198.1	-0.09	Downward
	PW-64A	Linn Gravel	4/19/2016	4.97	207.96	183.8	173.8	178.8		
PW-65	PW-65S	Willamette Silt	4/19/2016	3.30	209.76	205.6	195.6	200.6	-0.20	Downward
	PW-65A	Linn Gravel	4/19/2016	7.32	205.20	182.7	172.7	177.7		
PW-66	PW-66S	Willamette Silt	4/13/2016	4.60	206.76	204.4	194.4	199.4	-0.13	Downward
	PW-66A	Linn Gravel	4/13/2016	7.58	203.88	182.5	172.5	177.5		
PW-67	PW-67S	Willamette Silt	4/20/2016	5.69	207.02	205.2	195.2	200.2	-0.09	Downward
	PW-67A	Linn Gravel	4/20/2016	9.88	205.30	186.0	176.0	181.0		
PW-104/108	PW-104S	Willamette Silt	4/11/2016	5.43	217.33	205.2	200.2	202.7	0.29	Upward
	PW-108A	Linn Gravel	4/11/2016	0.00	223.58	183.9	178.9	181.4		

Notes:

feet amsl = feet above mean sea level

TOC = top of casing

ATTACHMENT B

Concentrations of Constituents of Concern in Groundwater and Restoration Completeness Evaluation for the Farm Ponds Parcels

Attachment B.1. Restoration Analysis Data Table for the Farm Ponds Parcels.

Farm Ponds Parcels Restoration Completeness Evaluation

COC	Well	Cleanup Level	Pre-Remedy Monitoring						Remedy Implementation								
			1989	1990	1991		1994		1995		1996	1997	1998	1999			
			Fall	Spring	Spring	Fall	Winter	Summer	Winter	Summer	Winter	Fall	Spring	Spring	Summer	Fall	Winter
Chlorinated Volatile Organic Compounds																	
PCE	PW-40A	5 ug/L	5 U	2 J	5 U	5 U	5 U	5 U	5 U	5 U	31	5 U	5 UJ	1 U	1 U	1 U	1 U
PCE	PW-40S	5 ug/L	120	95	73	67	37	33	26	18	5 U	14	11	5.8	5.87	2.16	3.81
PCE	PW-104S	5 ug/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TCE	PW-40A	5 ug/L	6	14	23	21	7	4 J	3 J	5 U	15	5 U	5 UJ	1 U	1 U	1 U	1 U
TCE	PW-40S	5 ug/L	45	50	66	54	52	61	48	37	2 J	37	24 DJ	25.9	22.63	31.84	19.09
TCE	PW-104S	5 ug/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,1-DCE	PW-40S	7 ug/L	5 U	4 J	4 J	4 J	2 J	2 J	15	1 J	2 J	5 U	5 U	2.9	2.79	2.71	2.93
VC	PW-40A	2 ug/L	10 U**	10 U**	1 J	1 J	10 U**	10 U**	10 U**	10 U**	10 U**	3	4 J	2.1	3.2	3.4	3.94
VC	PW-40S	2 ug/L	10 U**	11	5 J	4 J	10 U**	10 U**	11 U**	12 U**	10 U**	7 U**	2	1.8	2.68	4.04	2.54
1,1,2-TCA	PW-40A	3 ug/L	6	6	7	5	3 J	2 J	5 U**	5 U**	9	5 U**	5 UJ**	1 U	1 U	1 U	1 U
1,1,2-TCA	PW-40S	3 ug/L	41	27	26	18	11	11	9	7	5 U**	5 U**	5 U**	2.5	1.99	2.87	1.15
1,1,2-TCA	PW-104S	3 ug/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,1,2,2-TCA	PW-40A	0.175 ug/L	--	--	5 U**	5 U**	5 U**	5 U**	5 U**	5 U**	6	5 U**	5 UJ**	1 U**	1 U**	1 U**	1 U**
1,1,2,2-TCA	PW-40S	0.175 ug/L	5 U**	5	4 J	2 J	5 U**	5 U**	5 U**	5 U**	5 U**	5 U**	5 U**	1 U**	1 U**	2 U**	1 U**
1,2-DCA	PW-40A	5 ug/L	5 U	5 U	2J	1 J	5 U	5 U	5 U	5 U	6	5 U	5 UJ	1.2	1 J	0.85 J	1.17
1,2-DCA	PW-40S	5 ug/L	6	6	5	5	4 J	3 J	4 J	3 J	6	7	5	5.5	4.31	10.14	5.14
1,2-DCA	PW-104S	5 ug/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Metals																	
Arsenic (Total)	PW-44S	10 ug/L	--	--	6.8	10.8	--	--	--	--	--	--	--	--	--	--	--
Beryllium (Total)	PW-40A	4 ug/L	4 B	2.2 U	4 UL	4 UL	--	--	--	--	--	--	--	--	--	--	--
Beryllium (Total)	PW-40S	4 ug/L	7	9	4 U	4 UL	--	--	--	--	--	--	--	--	--	--	--
Beryllium (Total)	PW-43S	4 ug/L	--	--	10	4 UL	--	--	--	--	--	--	--	--	--	--	--
Chromium (Total)	PW-43S	100 ug/L	--	--	240	100	--	--	--	--	--	--	--	--	--	--	--

COC	Well	Post-Remedy Monitoring																																Current Phase Status
		2000			2001		2002		2003	2004	2005	2006	2007		2008	2009		2010	2011		2012		2013		2015	2016	2017	2018	2019		2020	2021	2022	
		Spring	Summer	Fall	Spring	Fall	Spring	Fall	Fall	Fall	Fall	Fall	Spring	Fall	Fall	Spring	Fall	Fall	Fall	Fall	Spring	Fall	Spring	Fall	Spring	Spring	Spring	Spring	Winter	Spring	Spring	Spring	Winter	
Chlorinated Volatile Organic Compounds																																		
PCE	PW-40A	1 U	1 U	1 U	1 U	1 U	1 U	0.5 U	1 U	0.5 U	0.5 U	0.5 U	--	0.5 U	0.1 U	0.5 U	--	--	--	--	--	--	--	--	--	0.5 U	--	--	--	--	--	--	--	COMPLETE
PCE	PW-40S	3.9	2.5	2.5	1.9	1.8	1.1	0.54	1 U	0.5 U	0.77	0.13 J	--	1.1	0.1 U	--	0.57	0.55	--	0.43 J	--	0.5 U	--	0.5 U	0.5 U	0.18 J	0.15 J	0.2 U	--	0.28 J	--	--	--	COMPLETE
PCE	PW-104S	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.3	4.69	3.01	9.78	4.05	5	2.4	--	RMP
TCE	PW-40A	1 U	1 U	1 U	1 U	1 U	1 U	0.5 U	1 U	0.5 U	0.5 U	0.5 U	--	0.5 U	0.1 U	--	0.5 U	--	--	--	--	--	--	--	--	0.5 U	--	--	--	--	--	--	--	COMPLETE
TCE	PW-40S	21.5	18	15.9	9.3	8.5	7.1	5.63	4.11	1.82	1.5	0.83	--	1.3	0.7	--	0.49 J	0.5 U	--	0.5 U	0.5 U	--	0.5 U	--	0.28 J	0.44 J	0.43 J	0.483	--	0.36 J	--	--	--	COMPLETE
TCE	PW-104S	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	19	10.9	7.6	13.3	9.95	9.2	6.41	--	RMP
1,1-DCE	PW-40S	3.2	2.8	2.5	1.6	1.9	1.2	1.93	1.46	0.87	0.67	0.52	0.38 J	--	0.6	--	0.5 U	0.5 U	--	0.5 U	--	0.5 U	--	--	0.5 U	0.5 U	0.5 U	0.2 U	0.4 U	--	--	--	--	COMPLETE
VC	PW-40A	3.9	4	3.4	2.8	2.6	2	1.09	1.12	0.88	0.58	0.5 U	--	0.48 J	0.3 J	--	0.5 U	--	--	--	--	--	--	--	--	0.32 J	--	--	--	--	--	--	--	COMPLETE
VC	PW-40S	3.7	2.9	2.4	1.8	4.2	1.1	4.55	3.19	2.97	1.7	2.7	--	0.85	2.4	--	0.5 U	0.5 U	--	0.5 U	--	0.5 U	--	0.5 U	0.5 U	0.3 J	0.5 U	0.472	--	0.4 U	--	--	--	COMPLETE
1,1,2-TCA	PW-40A	1 U	1 U	1 U	1 U	1 U	1 U	0.5 U	1 U	0.5 U	0.5 U	0.5 U	--	0.5 U	0.4 U	--	0.5 U	--	--		--		--			0.5 U	--	--	--		--	--	--	COMPLETE
1,1,2-TCA	PW-40S	1.2	1.2	1.2	1 U	1 U	1 U	0.5 U	1 U	0.5 U	0.5 U	0.5 U	0.36 J	--	0.1 U	0.12 J	--	0.13 J	--	0.5 U	--	0.5 U	--	0.5 U	0.5 U	0.5 U	0.5 U	0.25 U	--	0.25 U	--	--	--	COMPLETE
1,1,2-TCA	PW-104S	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	12.2	8.76	8.96	9.66	8.27	7.44	5.99	--	RMP
1,1,2,2-TCA	PW-40A	1 U**	1 U**	1 U**	1 U**	1 U**	1 U**	0.5 U**	1 U**	0.5 U**	0.5 U**	--	0.5 U**	0.1 U	0.1 U	--	0.5 U**	--	--	--	--	--	--	--	--	0.5 U**	--	--	--	--	--	--	--	COMPLETE
1,1,2,2-TCA	PW-40S	1 U**	1 U**	1 U**	1 U**	1 U**	1 U**	0.5 U**	1 U**	0.5 U**	0.5 U**	--	0.05 J	--	0.1 U	--	0.5 U**	0.5 U**	--	--	--	--	0.5 U**	0.5 U**	0.5 U**	0.5 U**	0.5 U**	0.25 U**	0.25 U**	--	--	--	--	COMPLETE
1,2-DCA	PW-40A	1.1	0.9 J	1.1	1.1	0.9 J	2	0.54	1 U	0.5 U	0.5 U	0.5 U	0.25 J	--	0.2 J	--	0.1 J	--	--	--	--	--	--	--	--	0.16 J	--	--	--	--	--	--	--	COMPLETE
1,2-DCA	PW-40S	4.8	3.8	6.6	2.6	3.6	3.9	4.73	4.28	2.63	1.8	1.8	0.86	--	1.7	--	0.12 J	0.5 U	--	0.5 U	--	0.5 U	--	0.5 U	0.5 U	0.36 J	0.28 J	0.453	0.2 U	--	--	--	--	COMPLETE
1,2-DCA	PW-104S	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.09	5.86	6.74	5.56	6.35	6.95	6.68	--	RMP
Metals																																		
Arsenic (Total)	PW-44S	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4.75	--	--	--	--	--	--	4.45	COMPLETE
Beryllium (Total)	PW-40A	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5 U	--	--	--	--	--	--	0.100 U	COMPLETE
Beryllium (Total)	PW-40S	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5 U	--	--	--	--	--	--	0.100 U	COMPLETE
Beryllium (Total)	PW-43S	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5 U	--	--	--	--	--	--	0.100 U	COMPLETE
Chromium (Total)	PW-43S	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5.05	--	--	--	--	--	--	5.61	COMPLETE

Notes

ug/L = micrograms per liter

COC = Constituent of Concern

U = Constituent not detected above the method reporting limit of "U"

J = Estimated concentration

-- = No sample collected

BOLD BLACK = COC detected in groundwater

BOLD RED = Constituent detected above the cleanup level

TCE = Trichloroethene

PCE = Tetrachloroethene

VC = Vinyl Chloride

1,1,2-TCA = 1,1,2-Trichloroethane

1,1,2,2-TCA = 1,1,2,2-Tetrachloroethane

1,2-DCA = 1,2-Dichloroethane

1,1-DCE = 1,1-Dichloroethene

** Indicates that the method reporting limit exceeds the cleanup level

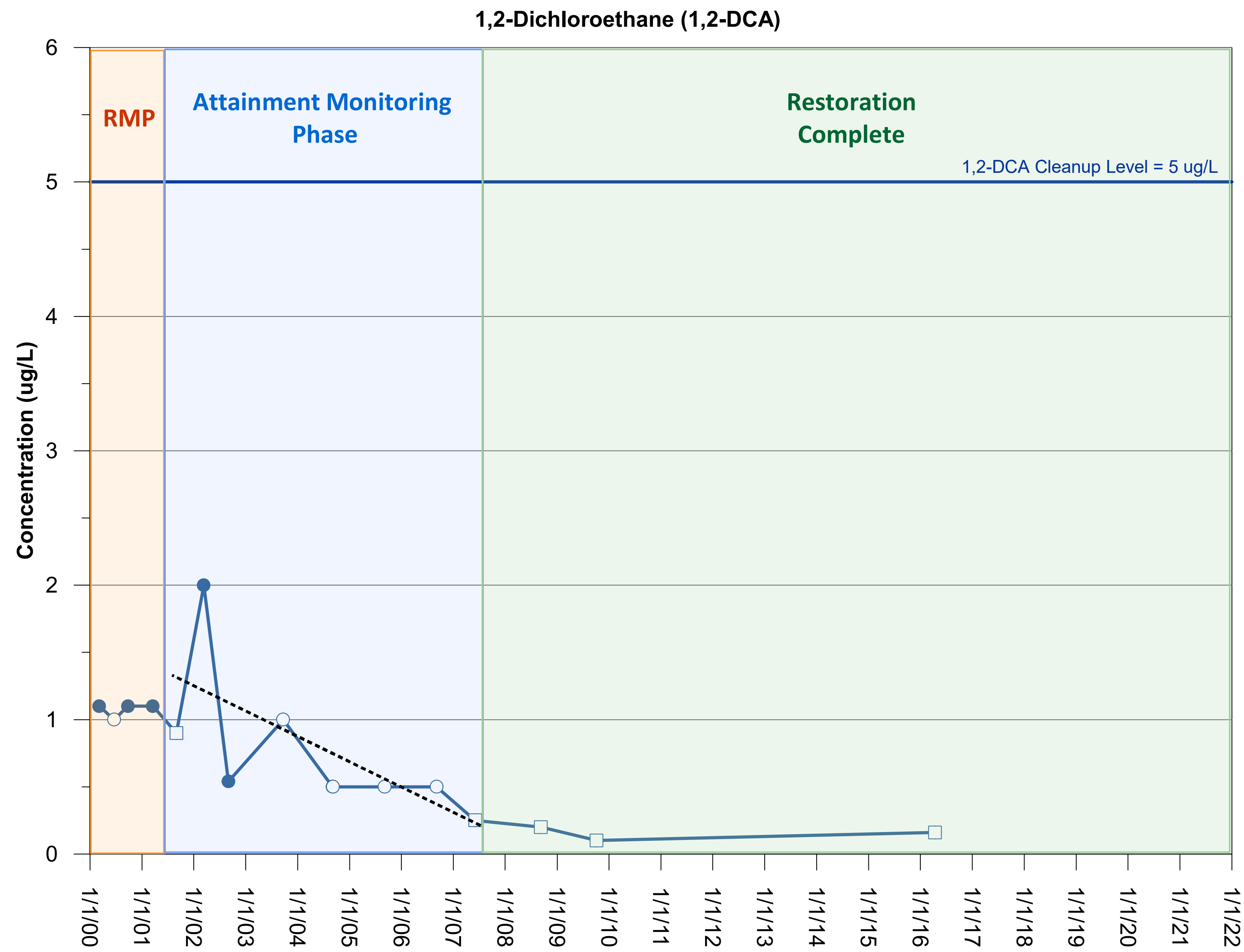
Quantitative Evaluation: Remediation Monitoring Phase

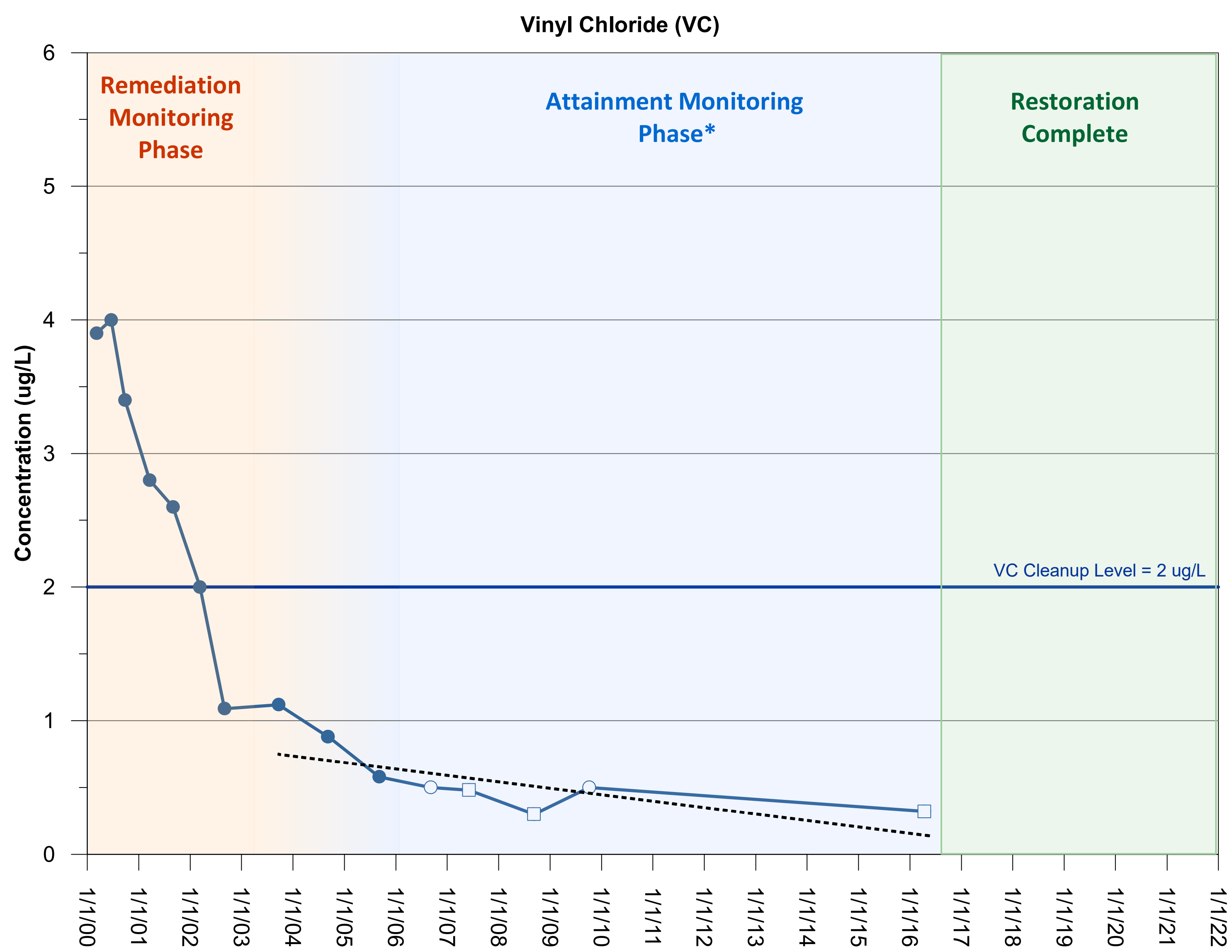
Quantitative Evaluation: Attainment Monitoring Phase

Quantitative Evaluation: Restoration Complete

DATA COLLECTED DURING THE RMP THAT ARE USED TO EVALUATE COC CONCENTRATION TRENDS DURING THE AMP

Semi-Quantitative Evaluation





Notes:
Plots display COC concentrations since the end of remediation in 1999.

ug/L = microgram per liter
COC = constituent of concern
DCA = dichloroethane
RMP = remediation monitoring phase
VC = vinyl chloride
*For Vinyl Chloride, the last three data points in the RMP were used in addition to data from the AMP to determine if the AMP is complete.

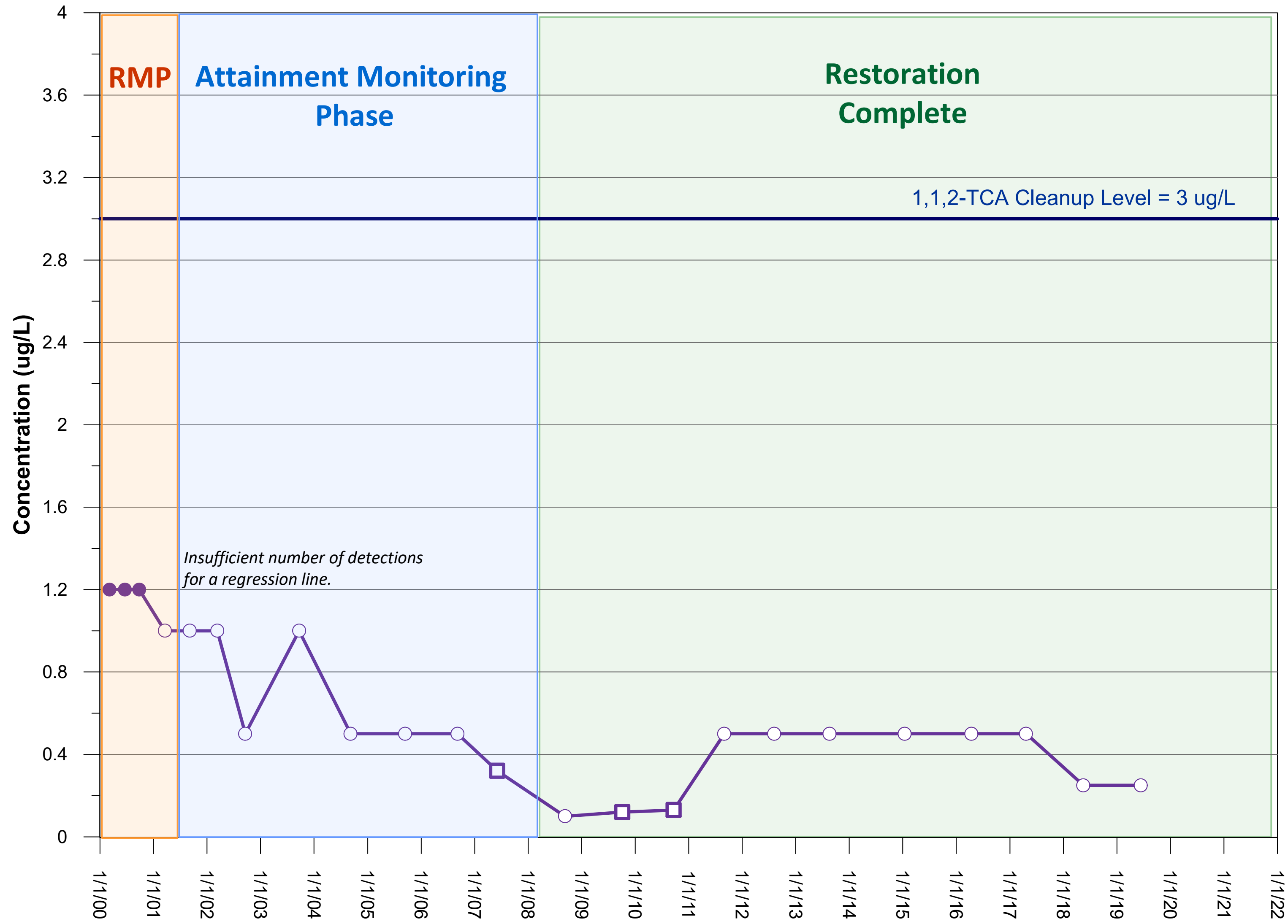
Legend

COC Cleanup Level
Detection
Non-Detect
Estimated Value (J-Flag)
Remediation Monitoring Phase
Attainment Monitoring Phase
Restoration Complete

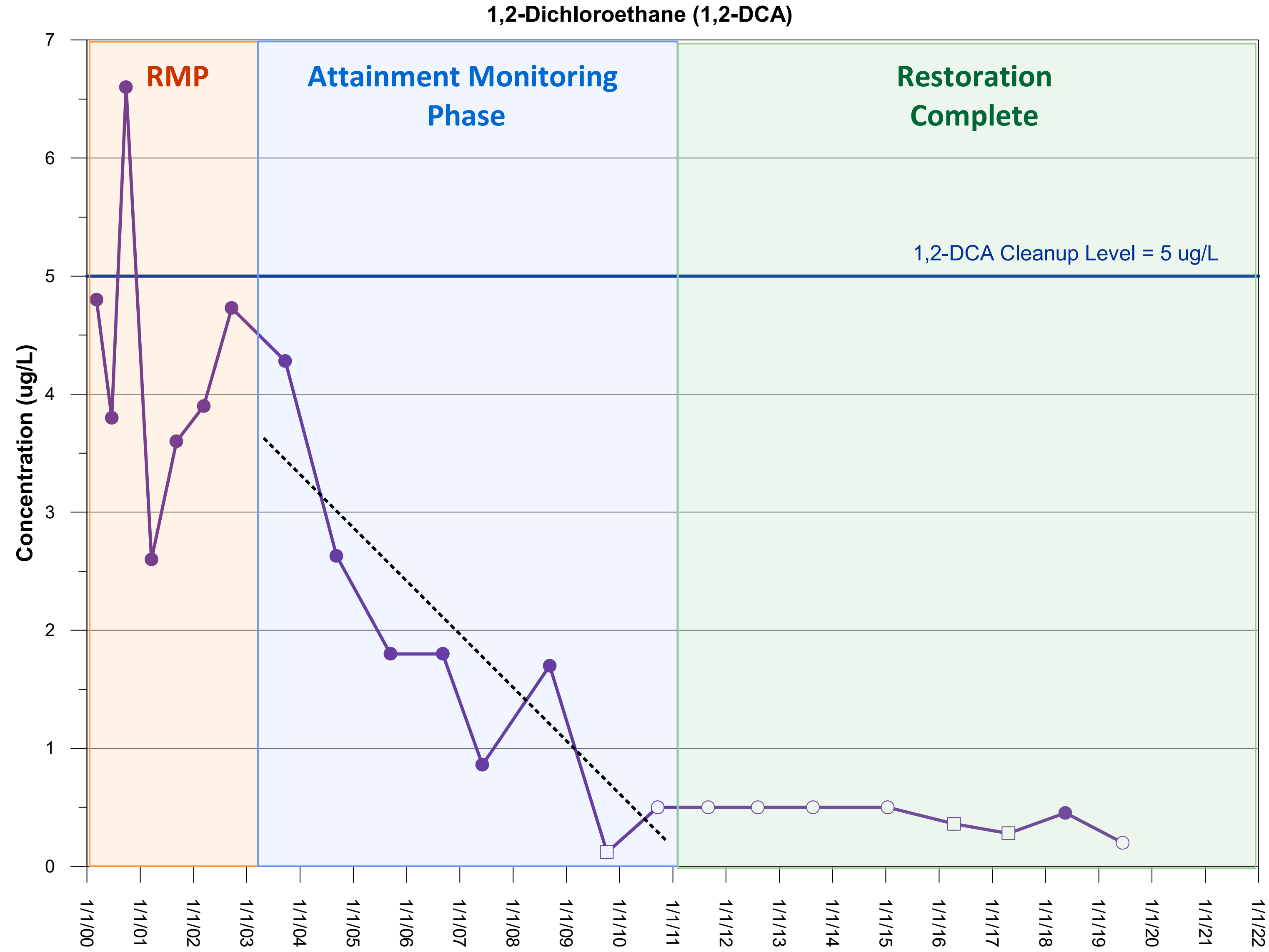
Attachment B.2
Well PW-40A
Constituents of Concern
Farm Ponds Parcels
Restoration Completeness Evaluation
ATI Millersburg Operations, Oregon

GSI Water Solutions, Inc.

1,1,2-Trichloroethane (1,1,2-TCA)



1,2-Dichloroethane (1,2-DCA)



Notes:
Plots display COC concentrations since the end of remediation in 1999.

ug/L = microgram per liter
COC = constituent of concern
DCA = dichloroethane
RMP = remediation monitoring phase
TCA = trichloroethane

Legend

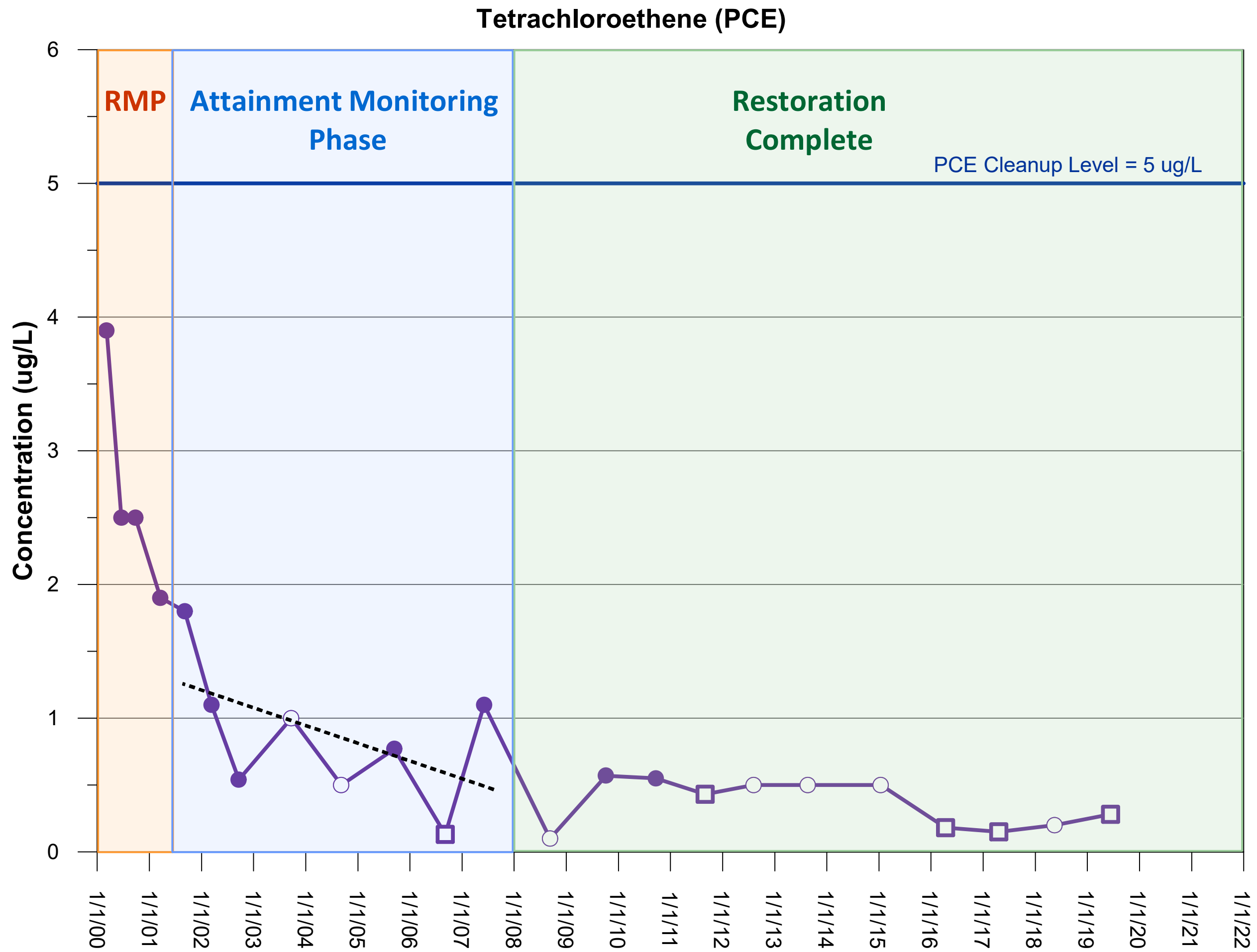
- COC Cleanup Level
- ● Detection
- ○ Non-Detect
- □ Estimated Value (J-Flag)
- Remediation Monitoring Phase
- Attainment Monitoring Phase
- Restoration Complete

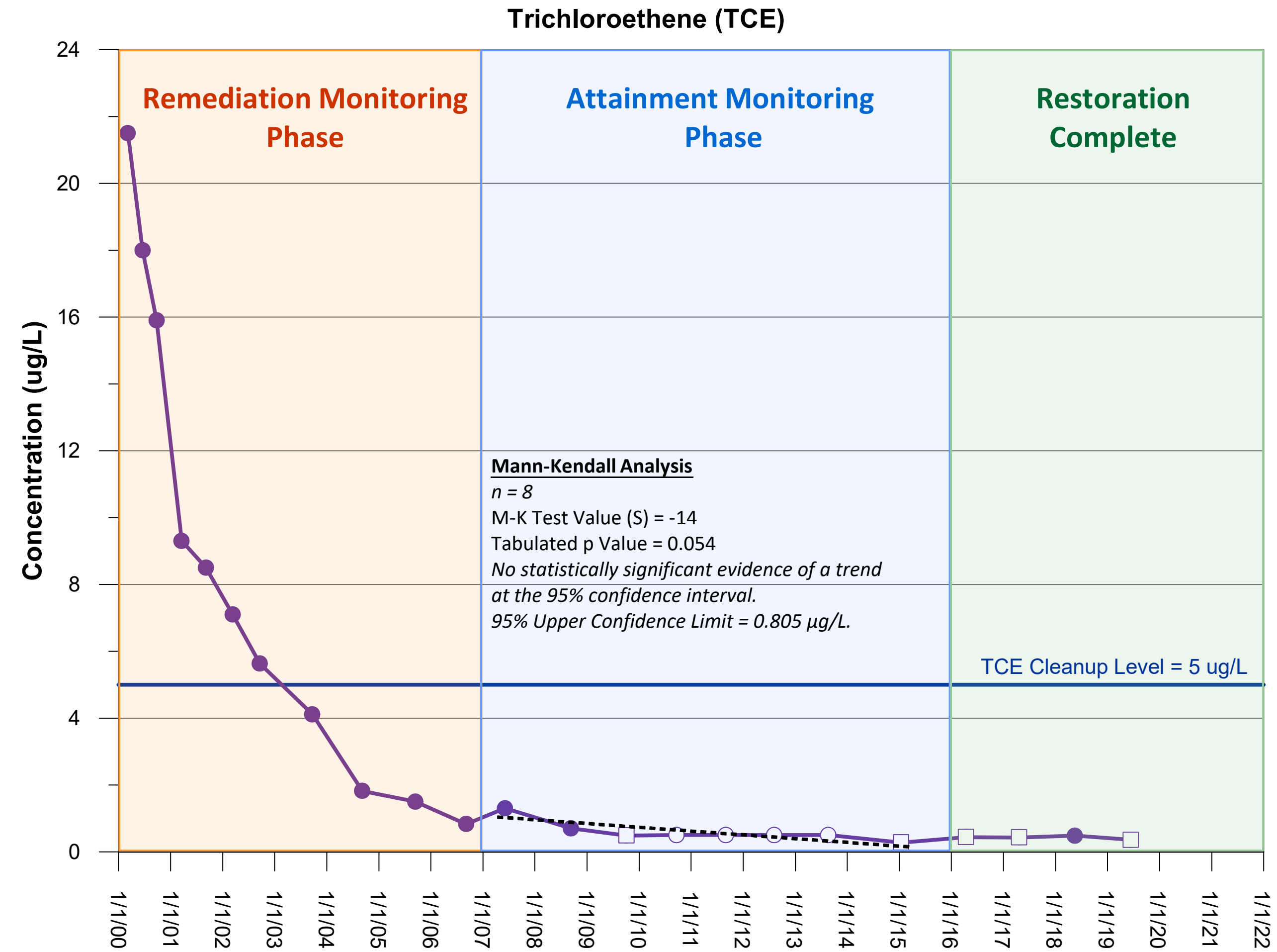
Attachment B.3a
Well PW-40S
Constituents of Concern
Farm Ponds Parcels
Restoration Completeness Evaluation
ATI Millersburg Operations, Oregon

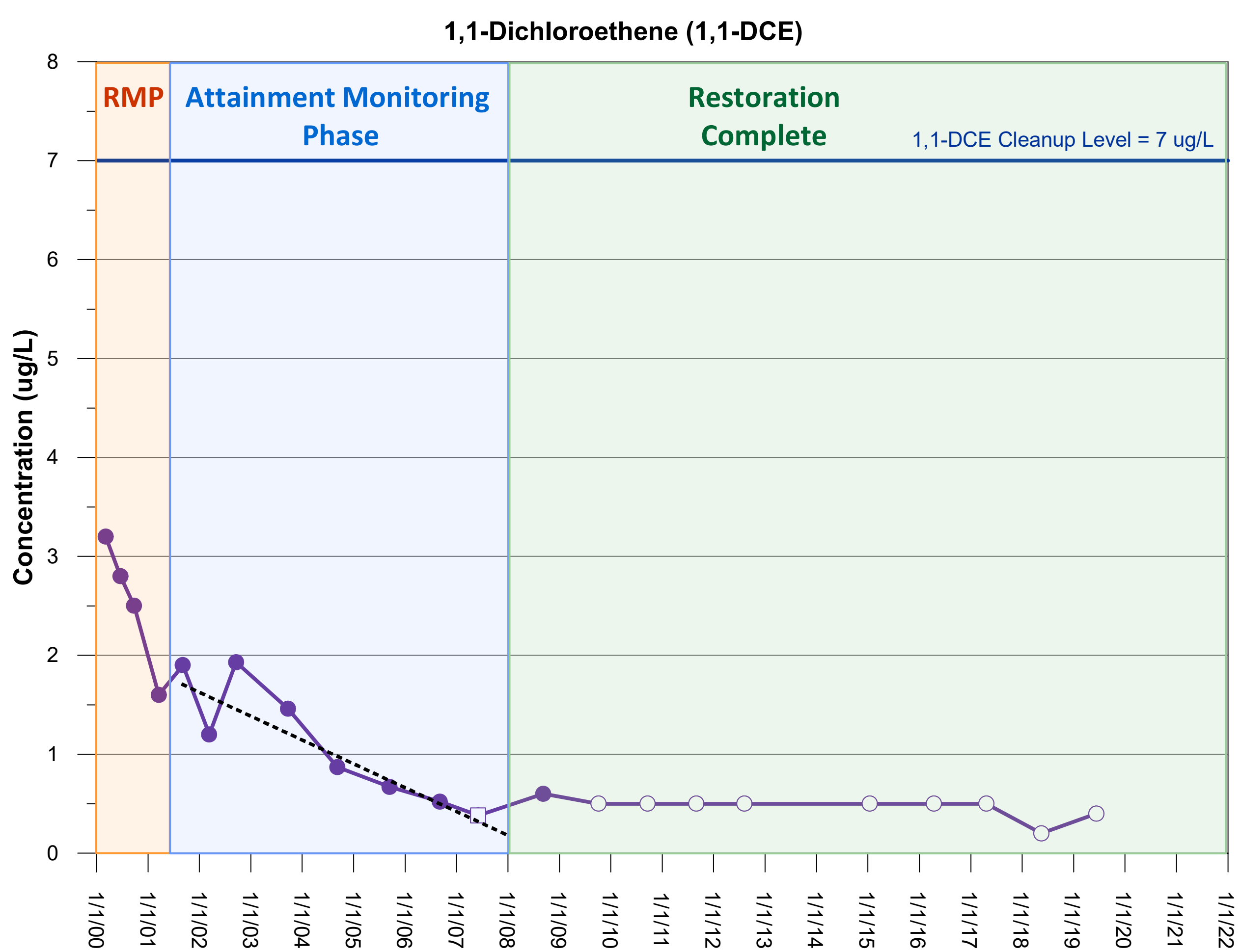
GSI Water Solutions, Inc.

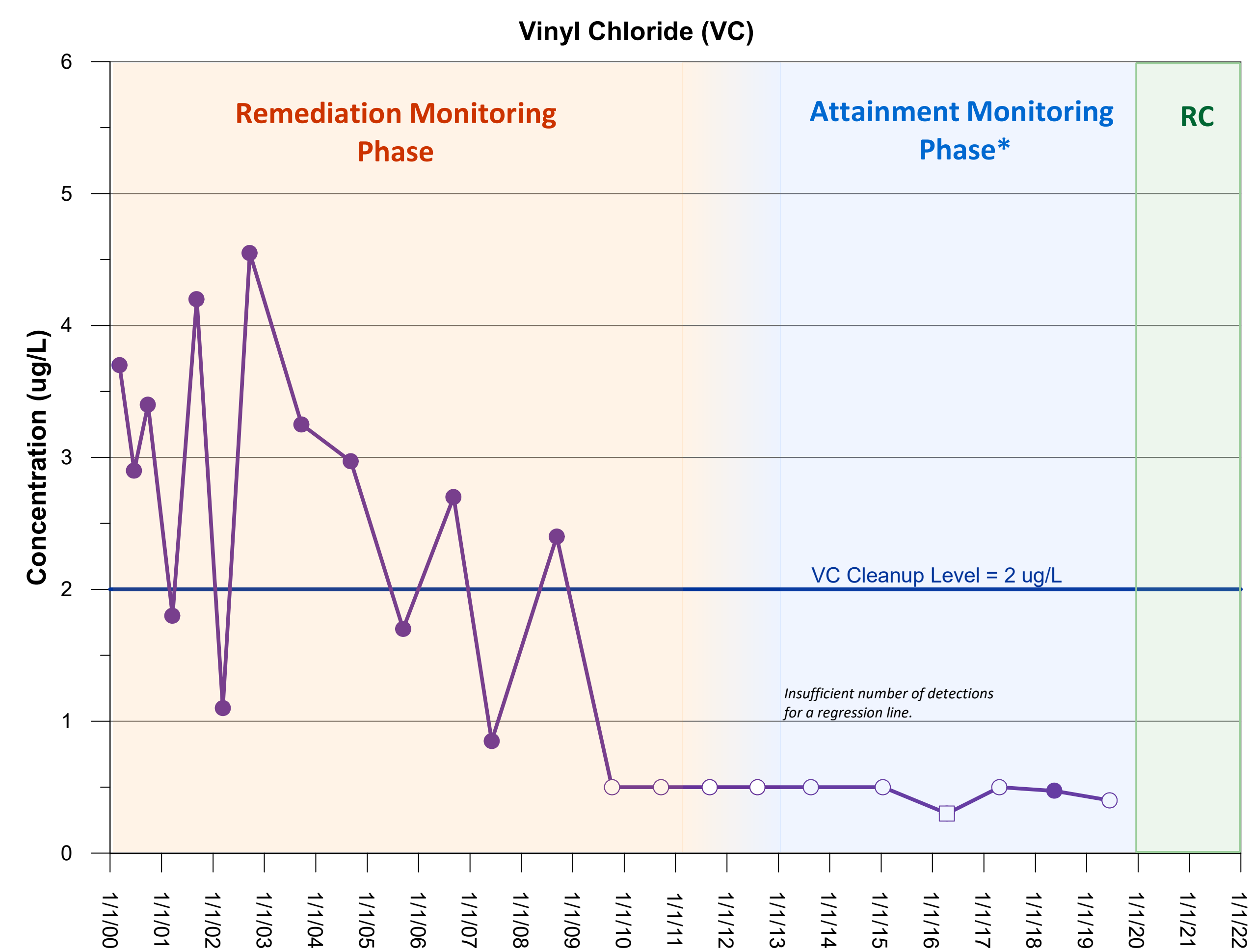
Attachment B.3b
Well PW-40S
Constituents of Concern

Farm Ponds Parcels
Restoration Completeness Evaluation
ATI Millersburg Operations, Oregon









Legend

- COC Cleanup Level
- Detection
- Non-Detect
- Estimated Value (J-Flag)
- Remediation Monitoring Phase
- Attainment Monitoring Phase
- Restoration Complete

Notes:
Plots display COC concentrations since the end of remediation in 1999.

ug/L = microgram per liter
COC = constituent of concern
PCE = tetrachloroethene
RC = restoration complete
RMP = remediation monitoring phase
TCE = trichloroethene
VC = vinyl chloride
*For Vinyl Chloride, the last two data points in the RMP were used in addition to data from the AMP to determine if the AMP is complete.

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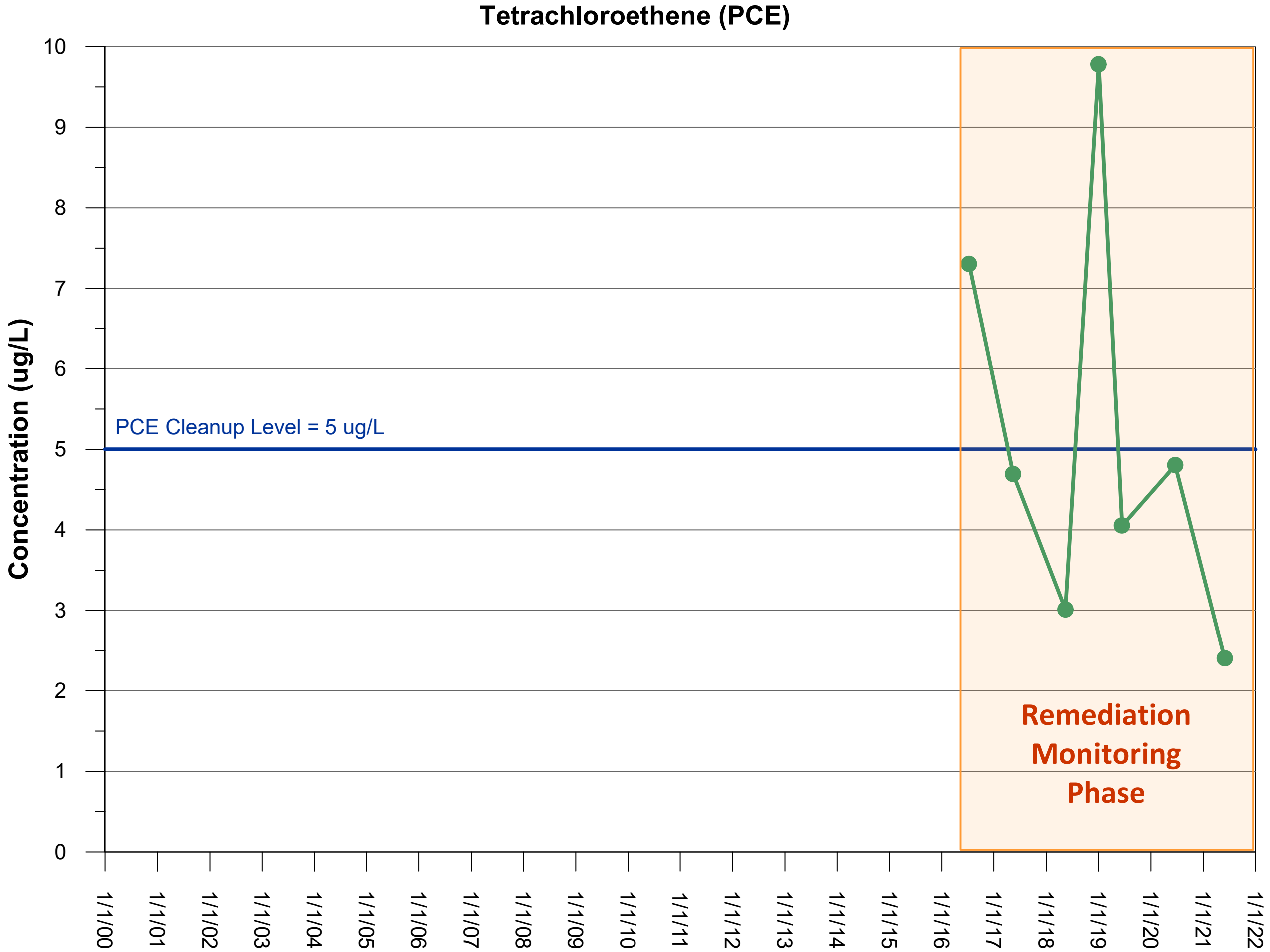
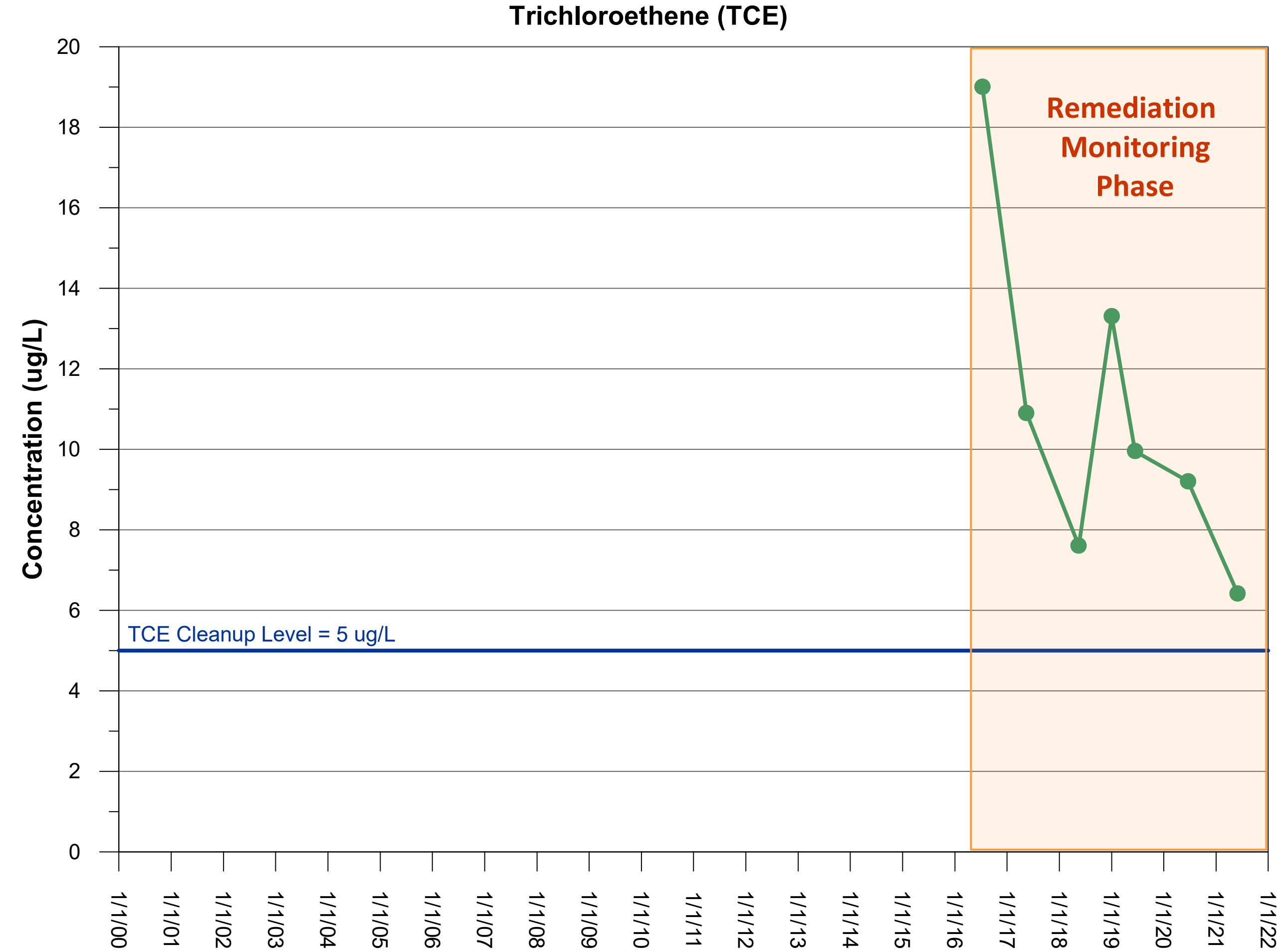
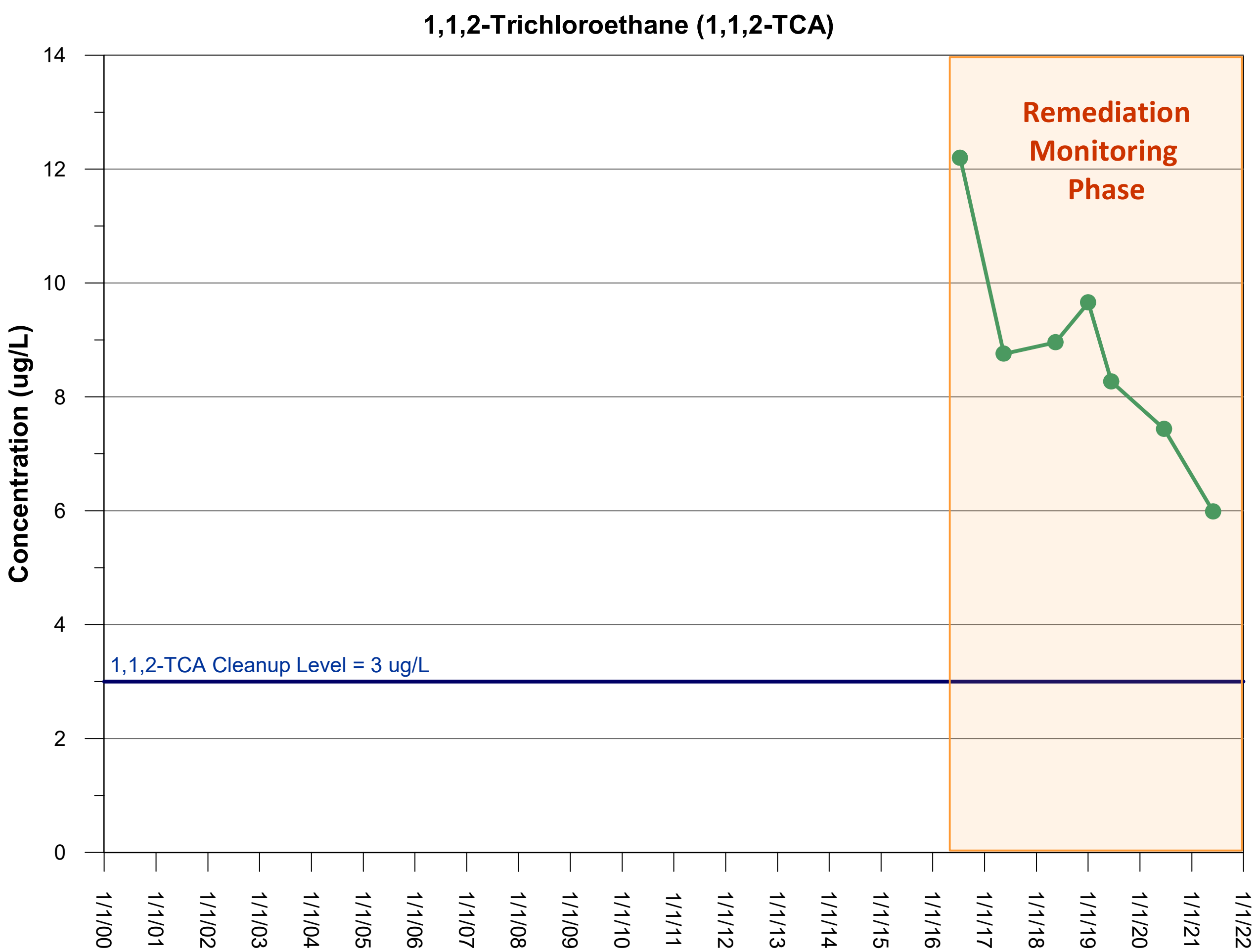
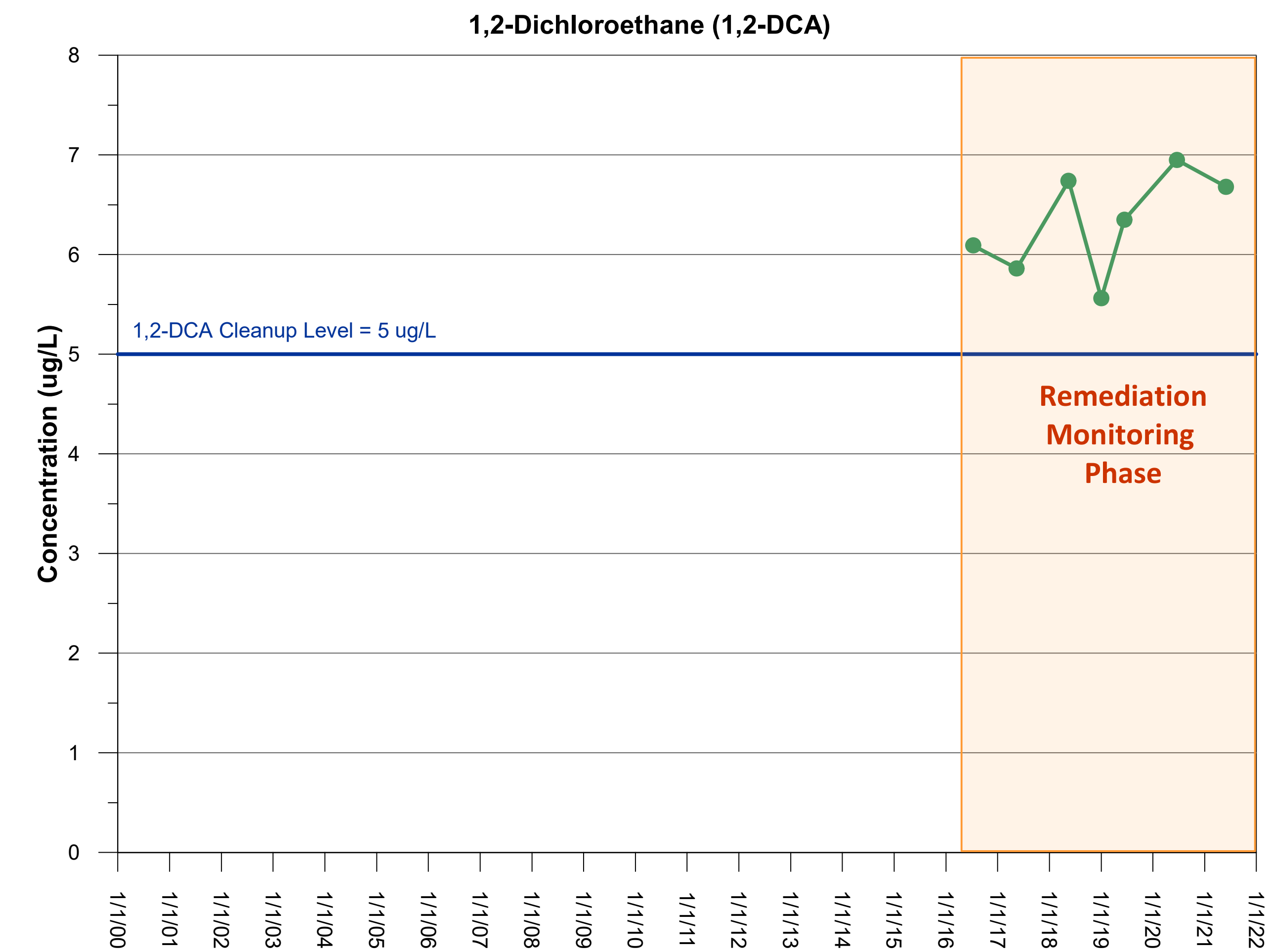
Attachment B.4
Well PW-104S
Constituents of Concern
Farm Ponds Parcels
Restoration Completeness Evaluation
ATI Millersburg Operations, Oregon









Legend

- COC Cleanup Level
- Detection
- Remediation Monitoring Phase

Notes:
Plots display COC concentrations since the end of active remediation activities in 1999.

ug/L = microgram per liter
COC = constituent of concern
DCA = dichloroethane
PCE = tetrachloroethene
TCA = trichloroethane
TCE = trichloroethene

GSI Water Solutions, Inc.

ATTACHMENT C

Technical Documentation for Mann-Kendall Trend Analyses and 95% Upper Confidence Limits

GSI Water Solutions, Inc.

Attachment C. Technical Documentation for Mann-Kendall Trend Analyses and 95% Upper Confidence Limit Calculations at the Farm Ponds Parcels

Date: April 14, 2022

1. Introduction

This attachment summarizes the methods used by GSI Water Solutions (GSI) to perform Mann-Kendall trend analyses and calculate the 95% Upper Confidence Limit (UCL) of the mean for constituents of concern (COCs) at the Farm Ponds Parcels. The Mann-Kendall analyses and 95% UCL calculations were conducted as part of a restoration completeness evaluation, and were performed with ProUCL Version 5.1 software.

2. Mann-Kendall Trend Analysis

This section summarizes the primary elements of a Mann-Kendall trend analysis as described in the *ProUCL Version 5.1 Technical Guide* (EPA, 2015) and other guidance documents [i.e., Alvarez and Illman (2006), Helsel et al. (2019), Gilbert (1987)]. The Mann-Kendall trend analysis is a nonparametric method to evaluate whether there is evidence of a statistically significant trend in time series data. According EPA (2015), the steps for performing a Mann-Kendall analysis include: (1) data entry, (2) calculation of a Mann-Kendall Test Value (S), and (3) comparison of a calculated *p*-value to a pre-determined level of significance (α, for example 0.05) to achieve a confidence interval of (1 - α) (for example, the 95% confidence interval, if α = 0.05). The following sections summarize these elements of a Mann-Kendall trend analysis in greater detail, as discussed in EPA (2015), Alvarez and Illman (2006), and Helsel et al. (2019).

2.1 Methods

2.1.1 Step 1: Data Entry

The first step in a Mann-Kendall trend analysis is to order the groundwater quality data by sampling event from oldest to newest. For duplicate data points, the average of the two results is used. Nondetects were replaced with a value of half the lowest method reporting limit.

2.1.2 Step 2: Mann-Kendall Test Value

The second step for applying a Mann-Kendall trend analysis is to evaluate the Mann-Kendall Test Value (*S*), which is calculated by ProUCL. The *ProUCL Version 5.1 Technical Guide* (EPA, 2015) provides guidance on interpretation of the Mann-Kendall Test Value (*S*) (EPA, 2015):

- If *S* > 0, the analysis suggests the presence of a potential upward and increasing trend over time.
- If *S* < 0, the analysis suggests the presence of a potential downward and decreasing trend over time.
- If S is close to zero, the analysis suggests that the data do not exhibit any evidence of an increasing or decreasing trend.

2.1.3 Step 3: The Calculated *p*-value and Comparison to Level of Significance α

The final step for applying a Mann-Kendall trend analysis is to calculate the *p*-value and compare it to the level of significance α to achieve a confidence interval of (1 - α). The *ProUCL Version 5.1 Technical Guide* (EPA, 2015) provides guidance on interpretation of the *p* value at a level of significance α and confidence interval 1-α.

- If S > 0 and $\alpha > p$ value, conclude that there is statistically significant evidence of an increasing trend at the α significance level.

- If S < 0 and $\alpha > p$ value, conclude that there is statistically significant evidence of a decreasing trend at the α significance level.

- If S is ~ 0 and $\alpha < p$ value, conclude that the data do not exhibit sufficient evidence of any significant trend at the α level of significance.

It is helpful to understand that, when evaluating environmental data, values of α that are $\leq$ 0.2 are generally acceptable for evidence of a statistically significant trend (i.e., an 80 percent confidence interval or higher) (Alvarez and Illman, 2006). GSI used a level of significance of α = 0.05 for the Mann-Kendall trend analysis at the Farm Ponds Parcels (i.e., a 95% confidence interval).

2.2 Results

Table 1 summarizes the results of the Mann-Kendall trend analyses at the Farm Ponds Parcels. As discussed in the main text of the document, the Mann-Kendall trend analysis was conducted for COC/well pairs that did not exhibit a *clear* upward or downward trend based on visual analysis. Output from ProUCL Version 5.1 is provided in the following pages.

Table 1. Updated Mann-Kendall Analysis.

Well	COC	Apparent Trend Line Slope (Visual Analysis)	Mann-Kendall Test Value (S)	Level of Significance (α)	Calculated *p*-value (*p*)	Mann-Kendall Trend Analysis Conclusion
PW-40S	TCE	Decreasing	-14	0.10	0.054	Insufficient evidence to identify a significant trend at the 95% significance level.

3. 95% Upper Confidence Limit of the Mean Calculations

A 95% confidence interval is a range that is 95% certain to contain the true value of a parameter. For example, the 95% confidence interval of the mean is a range of values that is 95% certain to contain the true mean. The 95% *upper* confidence limit is the value that the true mean is 95% certain to be below. Therefore, the 95% UCL of the mean is a conservative measure for evaluating whether the true mean concentration is below a regulatory standard (Helsel et al., 2019).

3.1 Methods

ProUCL Version 5.1 software was used to calculate the 95% UCL of the mean. There are several different techniques for calculating a 95% UCL of the mean, depending on the best-fit probability distribution for the data. ProUCL first determines whether the data can be fit by a parametric probability distribution (e.g., normal, gamma, lognormal) or are nonparametric (meaning the data cannot be fit by a specific probability distribution). Next, based on this probability distribution analysis, ProUCL selects the most appropriate technique for calculating the 95% UCL.

3.2 Results

Table 2 summarizes the results the 95% UCL of the mean calculations at the Farm Ponds Parcels. As discussed in the main text of the document, the 95% UCL of the mean was calculated for COC/well pairs that did not exhibit a *clear* upward or downward trend based on visual analysis. Output from ProUCL Version 5.1 is provided in the following pages.

Table 2. 95% UCL of the Mean.

Well	COC	Distribution	Recommended UCL Type	95% UCL
PW-40S	TCE	Parametric (normal distribution)	95% KM(t)	0.805

4. References

Alvarez, P. J. and W. A. Illman, 2006. Nonparametric Statistical Tests for Determining the Effectiveness of Natural Attenuation. Bioremediation and Natural Attenuation. Wiley Interscience, New Jersey, 551 pp.

EPA, 2015. ProUCL Version 5.1 Technical Guide: Statistical Software for Environmental Applications for Data Sets With and Without Nondetect Observations. 351 pp. Available online at: ProUCL 5.1 Technical Guide (epa.gov).

Gilbert, R. O., 1987. Statistical Methods for Environmental Pollution Monitoring. Van Nostrand Reinhold Company, New York.

Helsel, D. R., Hirsch, R. M., Ryberg, K. R., Archfield, S. A., and E. J. Gilroy, 2019. U. S. Geological Survey Statistical Methods in Water Resources: Chapter 3 of Section A, Statistical Analysis, Book 4, Hydrologic Analysis and Interpretation. Available online at: tm4a3.pdf - Statistical Methods in Water Resources (usgs.gov). 484 pp.

	A	B	C	D	E	F	G	H	I	J	K	L
1				Mann-Kendall Trend Test Analysis								
2			User Selected Options									
3			Date/Time of Computation	ProUCL 5.14/14/2022 9:44:03 AM					PW-40S			
4			From File	ProUCL_v2_a.xls								
5			Full Precision	OFF								
6			Confidence Coefficient	0.95								
7			Level of Significance	0.05								
8												
9			TCE									
10												
11			General Statistics									
12				Number or Reported Events Not Used	0							
13				Number of Generated Events	8							
14				Number Values Reported (n)	19							
15				Number Values Missing	11							
16				Number Values Used	8							
17				Minimum	0.28							
18				Maximum	1.3							
19				Mean	0.596							
20				Geometric Mean	0.545							
21				Median	0.5							
22				Standard Deviation	0.306							
23				Coefficient of Variation	0.513							
24												
25			Mann-Kendall Test									
26				M-K Test Value (S)	-14							
27				Tabulated p-value	0.054							
28				Standard Deviation of S	7.528							
29				Standardized Value of S	-1.727							
30				Approximate p-value	0.0421							
31												
32	Insufficient evidence to identify a significant											
33	trend at the specified level of significance.											

UCL Statistics for Data Sets with Non-Detects	
User Selected Options	
Date/Time of Computation	ProUCL 5.112/9/2021 1:57:04 PM
From File	ProUCL_v2_a.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

PW-40S

TCE

General Statistics

Total Number of Observations	8	Number of Distinct Observations	5
		Number of Missing Observations	11
Number of Detects	4	Number of Non-Detects	4
Number of Distinct Detects	4	Number of Distinct Non-Detects	1
Minimum Detect	0.28	Minimum Non-Detect	0.5
Maximum Detect	1.3	Maximum Non-Detect	0.5
Variance Detects	0.193	Percent Non-Detects	50%
Mean Detects	0.693	SD Detects	0.44
Median Detects	0.595	CV Detects	0.635
Skewness Detects	1.142	Kurtosis Detects	1.364
Mean of Logged Detects	-0.52	SD of Logged Detects	0.644

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.934	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.243	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.375	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.539	KM Standard Error of Mean	0.14
KM SD	0.319	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.805	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.77	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.96	95% KM Chebyshev UCL	1.151
97.5% KM Chebyshev UCL	1.415	99% KM Chebyshev UCL	1.935

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.211	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.659	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.18	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.396	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	3.432	k star (bias corrected MLE)	1.025
Theta hat (MLE)	0.202	Theta star (bias corrected MLE)	0.676
nu hat (MLE)	27.46	nu star (bias corrected)	8.197
Mean (detects)	0.693		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.144	Mean	0.524
Maximum	1.3	Median	0.456
SD	0.36	CV	0.687
k hat (MLE)	2.774	k star (bias corrected MLE)	1.817
Theta hat (MLE)	0.189	Theta star (bias corrected MLE)	0.288
nu hat (MLE)	44.38	nu star (bias corrected)	29.07
Adjusted Level of Significance (β)	0.0195		
Approximate Chi Square Value (29.07, α)	17.76	Adjusted Chi Square Value (29.07, β)	15.57
95% Gamma Approximate UCL (use when n>=50)	0.857	95% Gamma Adjusted UCL (use when n<50)	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.539	SD (KM)	0.319
Variance (KM)	0.102	SE of Mean (KM)	0.14
k hat (KM)	2.854	k star (KM)	1.867
nu hat (KM)	45.67	nu star (KM)	29.88
theta hat (KM)	0.189	theta star (KM)	0.289
80% gamma percentile (KM)	0.813	90% gamma percentile (KM)	1.065
95% gamma percentile (KM)	1.306	99% gamma percentile (KM)	1.843

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (29.88, α)	18.4	Adjusted Chi Square Value (29.88, β)	16.16
95% Gamma Approximate KM-UCL (use when n>=50)	0.875	95% Gamma Adjusted KM-UCL (use when n<50)	0.996

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	1	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.15	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.375	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.532	Mean in Log Scale	-0.781
SD in Original Scale	0.346	SD in Log Scale	0.561
95% t UCL (assumes normality of ROS data)	0.764	95% Percentile Bootstrap UCL	0.737
95% BCA Bootstrap UCL	0.788	95% Bootstrap t UCL	1.024
95% H-UCL (Log ROS)	0.903		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.757	KM Geo Mean	0.469
KM SD (logged)	0.5	95% Critical H Value (KM-Log)	2.355

	A–E	F	G–K	L
105	KM Standard Error of Mean (logged)	0.248	95% H-UCL (KM -Log)	0.83
106	KM SD (logged)	0.5	95% Critical H Value (KM-Log)	2.355
107	KM Standard Error of Mean (logged)	0.248		
108				
109	**DL/2 Statistics**			
110	**DL/2 Normal**		**DL/2 Log-Transformed**	
111	Mean in Original Scale	0.471	Mean in Log Scale	-0.953
112	SD in Original Scale	0.373	SD in Log Scale	0.626
113	95% t UCL (Assumes normality)	0.721	95% H-Stat UCL	0.864
114	**DL/2 is not a recommended method, provided for comparisons and historical reasons**			
115				
116	**Nonparametric Distribution Free UCL Statistics**			
117	**Detected Data appear Normal Distributed at 5% Significance Level**			
118				
119	**Suggested UCL to Use**			
120	95% KM (t) UCL	0.805		
121				
122	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
123	Recommendations are based upon data size, data distribution, and skewness.			
124	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
125	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
126				
127				

ATTACHMENT D

Detected Constituents at the Farm Ponds Parcels

Attachment D. Detected Constituents at the Farm Ponds Parcels.

Farm Ponds Parcels Restoration Completeness Evaluation

Constituent	Detected in Groundwater?
trans-1,2-Dichloroethene	Yes
Trichloroethene (TCE)	Yes
Tetrachloroethene (PCE)	Yes
Vinyl chloride (VC)	Yes
1,1,1-Trichloroethane (TCA)	Yes
2-Chloroethylvinylether	Yes
1,1,2-Trichloroethane (TCA)	Yes
1,1,2,2-Tetrachloroethane (TCA)	Yes
1,1-Dichloroethane (DCA)	Yes
1,2-Dichloroethane (DCA)	Yes
1,1-Dichloroethene (DCE)	Yes
cis-1,2-Dichloroethene (DCE)	Yes
Acetone	Yes
Chloroform	Yes
Cyanide (Total)	Yes
Fluoride	Yes
Alkalinity as CaCO3	Yes
Nitrate	Yes
Ammonium	Yes
Ammonia	Yes
Chloride	Yes
Sulfate	Yes
Sulfide	Yes
Aluminum (Total)	Yes
Antimony (Total)	Yes
Arsenic (Total)	Yes
Barium (Total)	Yes
Beryllium (Total)	Yes
Cadmium (Total)	Yes
Calcium (Total)	Yes
Chromium (Total)	Yes
Copper (Total)	Yes
Iron (Total)	Yes
Lead (Total)	Yes
Magnesium (Total)	Yes
Manganese (Total)	Yes
Methane	Yes
Methylene chloride	Yes
Nickel (Total)	Yes
Potassium	Yes
Selenium (Total)	Yes
Silver (Total)	Yes
Sodium (Total)	Yes
Specific Conductivity	Yes
Thorium	Yes
Thorium-228	Yes
Thorium-230	Yes
Thorium-232	Yes
Tin (Total)	Yes
Zinc (Total)	Yes
Total Organic Carbon	Yes
Total Suspended Solids	Yes
Total Dissolved Solids	Yes
Carbon disulfide	Yes
Uranium (Total)	Yes
Zirconium	Yes
Gross Alpha	Yes
Radium-226/228	Yes